DOCUMENT RESUME

ED 239 918 SE 044 104

AUTHOR	Appel, Gary; And Others
TITLE	The Growing Classroom: A Garden-Based Science and Nutrition Curriculum for 2nd through 6th Grades. Book 2: Science.
INSTITUTION	Live Oak School District, Santa Cruz, CA.
SPONS AGENCY	Department of Education, Washington, DC.
PUB DATE	82
NOTE	195p.; Developed by Project Life Lab. For Books 1 and 3, see SE 044 103 and SE 044 105.
AVAILABLE FROM	Friends of the Harvest, 809 Bay Ave., Suite H, Capitola, CA 95010 ($33.00 per set).
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052)
EDRS PRICE	MF01/PC08 Plus Postage.
DESCRIPTORS	Communication Skills; Conservation Education; Demonstration Programs; Discovery Learning; Elementary Education; *Elementary School Science; Entomology; *Environmental Education; Experiential Learning; *Interdisciplinary Approach; Learning Activities; *Outdoor Education; Perception; Photosynthesis; Problem Solving; *Science Activities; Validated Programs
IDENTIFIERS	PF Project; Project Life Lab

ABSTRACT

This guide for teaching science is Book Two in Project Life Lab's (Santa Cruz, California) three-part curriculum for a garden-based science and nutrition program for grades 2-6. The curriculum is designed for use as an integrated program, but the books can be used independently. It is suggested that the use of student journals can greatly enhance the effectiveness of the curriculum by providing a place for students to record data and observations as well as feelings. The use of journals is referred to in many of the lessons. Divided into 10 units, this book covers indoor and outdoor science activities on: (1) problem solving and communication; (2) awareness and discovery of perceptions; (3) the many aspects of soil; (4) the mysteries of growing; (5) photosynthesis; (6) cycles and changes, with a focus on decomposition and decay; (7) interdependence in human and animal communities; (8) the ecology and anatomy of insects and flowers; (9) ways energy consumption patterns can be changed; and (10) ways for children to conserve and recycle. Each lesson provides the stated purpose of the lesson, a list of all necessary materials, the type of activity to be carried out along with needed background information, discussion questions for tying the lesson together, and additional activities and follow-up lessons. (JW)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED239918

The Growing Classroom

Book 2

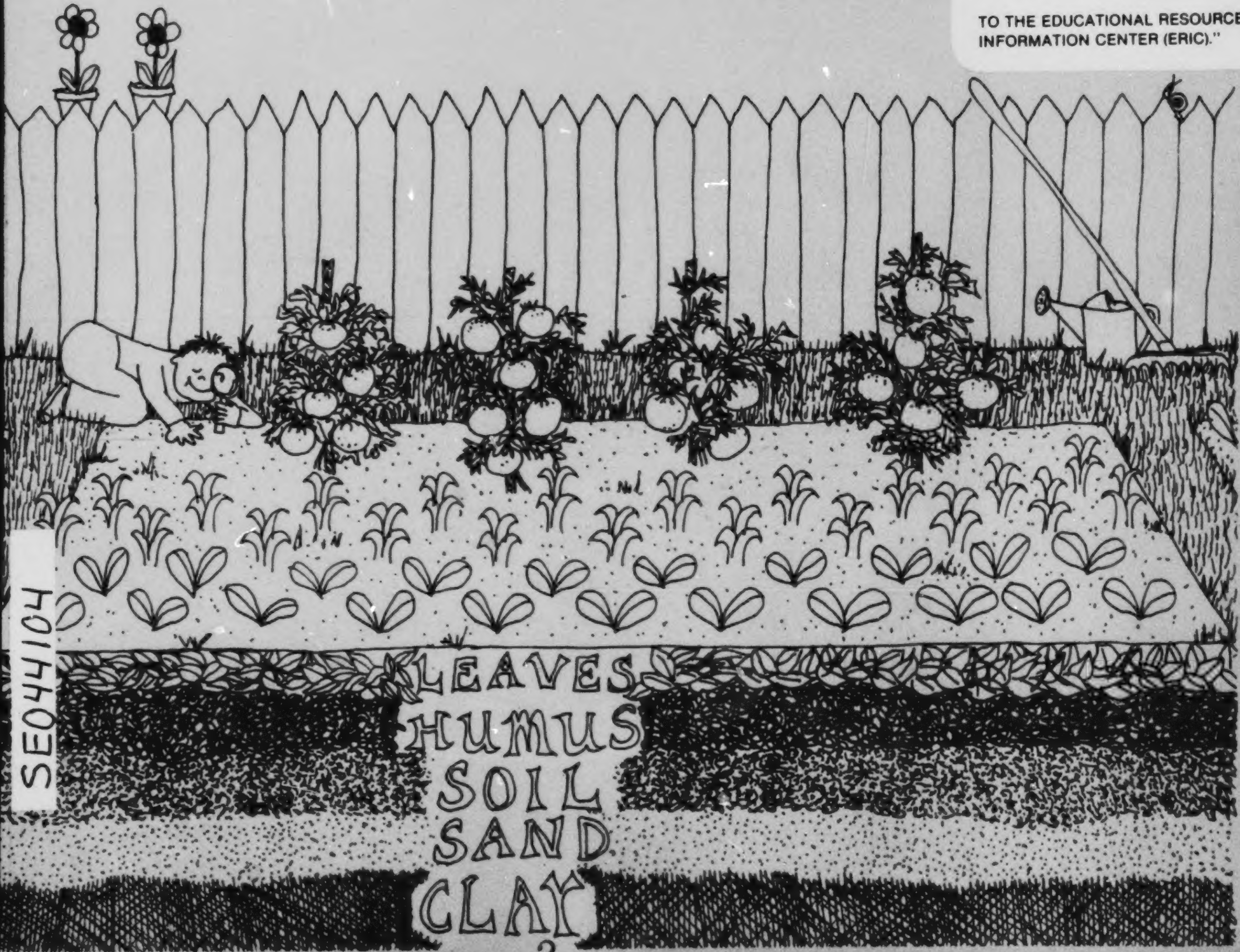
Science

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.
☑ Minor changes have been made to improve reproduction quality.

- Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Gary Appel
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."



SE044104

CALIFORNIA CENTERS FOR EDUCATIONAL IMPROVEMENT

NORTHERN
Office of the Butte County Superintendent of Schools
5A County Center Drive
Oroville, CA 95965

CENTRAL
Office of the Santa Clara County Superintendent of Schools
100 Skyport Drive
San Jose, CA 95115

SOUTHERN
Office of the Los Angeles County Superintendent of Schools
9300 East Imperial Highway
Downey, CA 90242

PROJECT OVERVIEW

CATALOG NUMBER: FP 000 359

PROJECT TITLE: Life Lab (2-6)

LOCAL EDUCATIONAL AGENCY:

Live Oak School District

ABSTRACT:

Life Lab is a science and nutrition program which facilitates critical thinking and academic learning as applied to an indoor or outdoor laboratory site. The laboratory allows students to apply concepts in science: problem solving/communication; awareness/discovery; soil; growing; photosynthesis; cycles and changes; interdependence; insects, flowers, and pollination; energy; and recycling. Concepts in nutrition are not only learned but also integrated with student eating habits as the students apply units in food choices, basic 4 food groups, nutrients, digestion, consumerism, and recipes. The curriculum, entitled The Growing Classroom, consists of three books. Book 1 is a guide to starting a school garden. Book 2 contains the ten science units listed above. Book 3 is the nutrition curriculum. The curriculum is best used as an integrated program; however, the books can also be used independently with success. Teachers with little background in science and nutrition find the activities easy to teach.

ADDRESS:

Project Life Lab
966 Bostwick Lane
Santa Cruz, CA 95062

CONTRACT: ESEA Title IV-C, #4296
E/I 1982-83
PUBLICATION DATE: 1982

STATUS: Active

DESCRIPTORS:
Critical Thinking
Demonstration Programs
Environmental Education
Interdisciplinary Approach
Learning Laboratories
Nutrition Instruction
Outdoor Education
Sciences

TARGET GROUP(S):
Elementary School Students
Elementary School Teachers

TEACHING METHODS:
Discovery Learning
Experiential Learning
Group Instruction
Interdisciplinary Approach
Learning Laboratories

LEARNING ACTIVITIES:
Gardening
Health Activities
Outdoor Activities
Science Activities

PROJECT MATERIALS:

Catalog Number	Title	Site
FD 002 112	The Growing Classroom Book 1: Becoming a Farmer (2-6)	C/N/S
FD 002 113	The Growing Classroom Book 2: Science (2-6)	C/N/S
FD 002 114	The Growing Classroom Book 3: Nutrition (2-6)	C/N/S

DA
5/83

THE GROWING CLASSROOM

A Garden-Based Science and Nutrition Curriculum

For 2nd through 6th Grades

Roberta Jaffe
Director

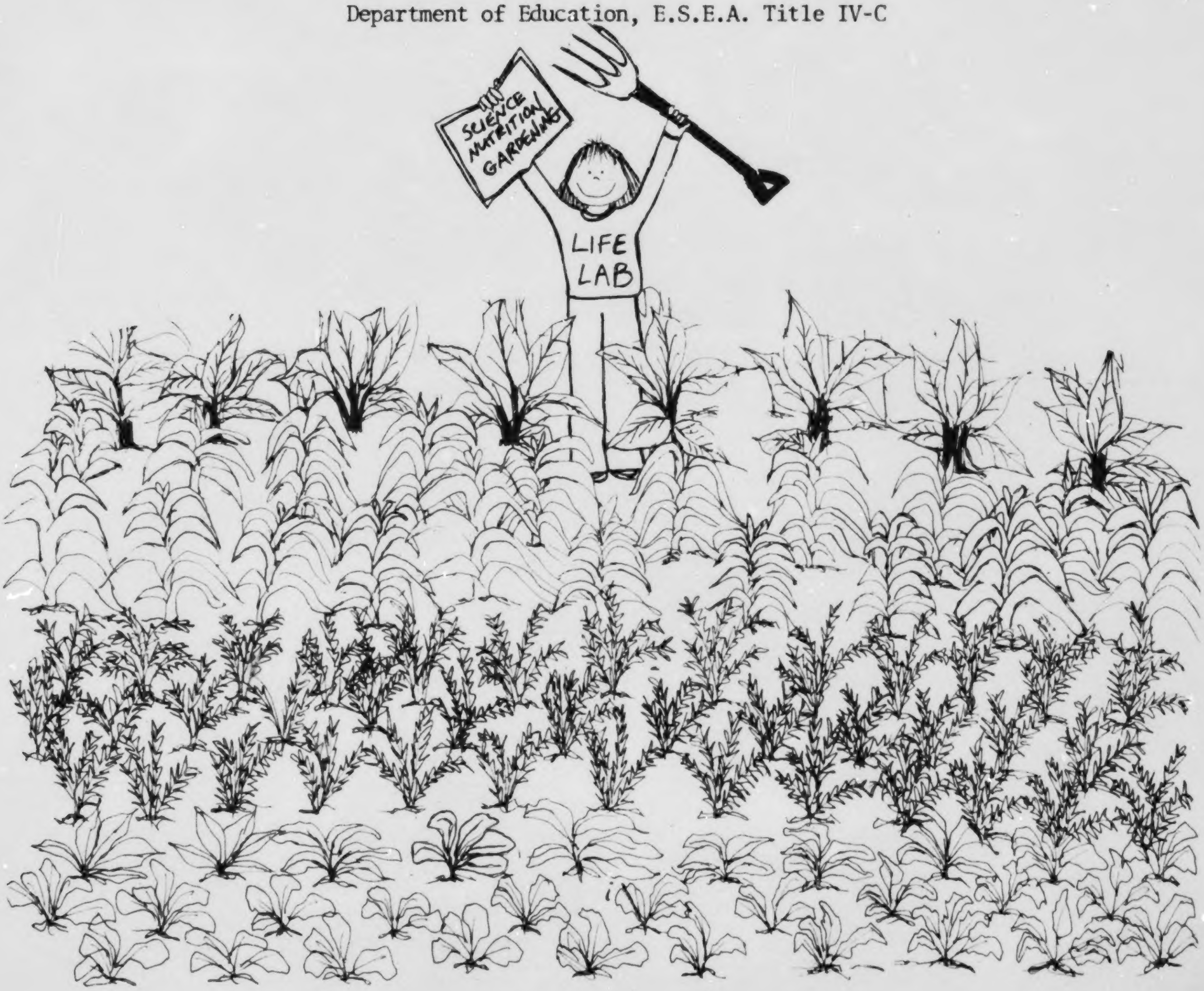
Margaret Cadoux
Garden Manager

Gary Appel
Science Coordinator

Kate Murray
Illustrator

developed by
Project Life Lab
Live Oak School District
Santa Cruz, CA

through funds provided by the
Department of Education, E.S.E.A. Title IV-C



Science Is Everywhere

The most important subject around,
Is science, of course, I've clearly found,
It's in each breath of air we breathe,
In all the chlorophyll we receive.

It helps the farmer tend his grain,
And sometimes even makes it rain,
It studies beehives, queens, and drones,
It's in the wires of telephones.

Cool earthworms oozing under rocks,
The habitat of the desert fox,
Planets hanging out in space,
Even treatment of our waste.

The coral snake, the arctic tern,
Huge blue whales and long green fern,
The isolation of our genes,
Household products that help us clean.

Our gasohol and fossil fuel,
The dimensions of a metric rule,
Tornadic winds and solar heat,
The vitamins and minerals found in meat.

Bugging, cloning, computer advice,
Test tube babes and super rice,
TV, UFOs, volcanic ash,
Ointment for a stubborn rash.

Acoustics in a certain place,
Plastic surgery on the face,
Insects and mollusks all around,
Big Foot's imprints on the ground.

The paper making up this page,
Why sausage needs a bit of sage,
The diets to keep us slim or fat,
And wine fermenting in the vat.

It's why the sky is gray or blue,
And how each morning brings the dew,
It's fire and ice and foam and mace,
It's the factor that helps one win a race.

It's superstition's bitter foe,
No guessing here, you have to know,
It's nuclear power, fierce and strong,
It's balance in nature that can't go wrong.

It's mist and fogged-up window panes,
And paint to mark off parking lanes,
The brilliance of a rainbow's hue,
The total existence of me and you.

I could go on, and on, and on,
With things here now, and long, long,
gone,
The list could grow, and grow, and grow,
From lofty skyscrapers to rising dough.

So science, my friends, is everywhere,
In foods we eat, and clothes we wear,
It's why there's calm before a storm,
It's life itself in every form!

Laura G. Johnson is a Sixth-Grade Science Teacher at Carver School, Milledgeville, Georgia.

©1982 by Live Oak School District, Santa Cruz, California 95062. All rights reserved. No part of this book may be reproduced without the prior written permission of the publisher.

1st printing: April, 1982 thanks to the California Dept. of Education, Title IV-C
2nd printing: November, 1982 thanks to the California Dept. of Food & Agriculture, Division of Integrated Pest Management

Published by FRIENDS of the HARVEST, a non-profit organization dedicated to improving elementary science education. For more information or sets of The Growing Classroom write:

Friends of the Harvest
966 Bostwick Lane
Santa Cruz, California
95062

HOW TO USE THESE BOOKS

This curriculum has been prepared as a tool for teacher use in developing a garden-based science and nutrition program. It is divided into three books for easy use. All sections and units are identified with a salmon-colored cover page. The pages of the three books are numbered in sequence to facilitate cross-referencing.

Book One is a guide to starting your school garden. It consists of three sections:

- Breaking Ground
- Cultivating Support For Your Growing Classroom
- Basic Gardening and Experimental Beds

Book One contains a Table of Contents for all three books. In addition, Books Two and Three have individual Table of Contents.

Book Two contains the Science Curriculum. It is divided into ten units:

- Problem Solving/Communication
- Awareness/Discovery
- Soil
- Growing
- Photosynthesis
- Cycles and Change
- Interdependence
- Insects, Flowers, and Pollination
- Energy
- Recycling

Book Three contains the Nutrition Curriculum. It is divided into six units:

- Food Choices
- Basic Four
- Nutrients
- Digestion
- Consumerism
- Recipes

The Science, Nutrition, and Gardening Curriculum is best used as an integrated program. The books can also be used independently. For example, you may choose to use the Nutrition book, foregoing the Science and Gardening books. Or you may simply use the Gardening book and start a class garden. Thus, you can develop your program one step at a time.

The salmon-colored cover pages of the Garden, Science, and Nutrition Curriculum units include: the unit title, a brief unit summary, titles of that unit's lessons, recommended grade levels, and a list of places to find a few special materials.

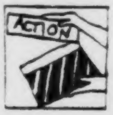
Each of the lessons is presented in a similar format. The lesson format is presented below:

Title

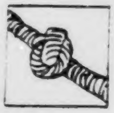
purpose

The purpose of the lesson in terms of the student is stated here.

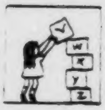
Materials: All necessary materials are listed here. Those that require special attention are noted with a star.★ Information on finding these materials is listed on the first page of each unit, under the unit summary.



The action is described here, and any needed background information is provided.

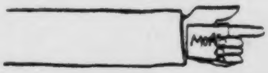


The knot is intended to tie the lesson together through the use of discussion questions. It is designed to assist you in determining if your objectives were reached.



Additional activities relating to the ACTION are suggested here as follow-up lessons. The page numbers of lessons in other units that support this lesson are listed here in some cases.

This means that the lesson is continued on the next page.



In addition, use of a student journal can greatly enhance the effectiveness of this curriculum. Journals can serve as both a place for students to record data and information regarding their experiments, and as a focus for feelings and observations. The more kids explore their world, the more they want to communicate the results of their explorations. Capitalize on this through use of the journal. It is referred to in many lessons.

SCIENCE

BOOK TWO

Problem Solving/Communication. 85

Sinking Ship 87
Count Off. 89
I Just Love Applause 90
Lap Game 91
Lighthouse 92
Knots. 94
Skis 95
Monster Mash 97
Six Bits 98
Tell It Like It Is 101
10-4 Good Buddy. 103
All or Nothing 104
Five Squares 105

Awareness/Discovery. 107

Candid Camera. 109
The Unnature Trail 110
Ear-Ye, Ear-Ye 112
Only the Nose Knows. 113
6 of 1, ½ Dozen of the Other 115
Everyone Needs a Rock. 116
See No Evil, Hear No Evil. 118
Mystery Powders. 119
Little Munchkins 120
Sharp Eyes 121
Burma Shave. 122
Lost in the Ozone Again. 123
Big Ears 124

Soil 125

Behind Door # 3 We Have....Soil! 127
Sensual Soil 128
Star Trek. 129
Living in the Soil .131
Soil Doctors 133
Water Water Everywhere 134
The Great and Powerful Earthworm 135

Growing. 137

Spaceship Earth. .139
Big Mac Attack 140
Seedy Character. .142
Adapt-A-Seed 144
Samson and Delilah 145
It's Getting Stuffy in Here. 146
Luna Seeds 147
Lotus Seeds. 148
Growing, Growing, Gone 149
Glass Seed Sandwich. 150
Let's Get to the Root of This. 151
Making and Using Root View Boxes 152
Run Root Run 153
Let's Get a Handle on This 154
Which Way Did It Grow. 155
Plant Sweat. 156
Room to Live 157
Seed To Earth...Do You Read Me 158
The Big Sleep. 160

Photosynthesis 161

Sugar Factories. .163
Let's Make a Deal. 164
Magical Mystery Tour 165
You Light Up My Life 166
Plants Need Light, Too 167

Cycles and Changes 169

The Power of the Circle. 171
Adopt a Tree 175
Dr. Jekyl and Mr. Hyde 176
You Look Different Than the Last Time I Saw You. 177
Bring in the Clean-up Crew 178
Compost Bags 179
Compost Bags - Part II 180
Mother Earth 181
This Earth is Sacred 183

Interdependence. .185

Eat the Earth. 187
I Eat the Sun. 188
The Sun's Restaurant 189
Kill'Em Dead 190
Refried Cattail with Filet of Beaver Tail. 191
The Day They Parachuted Cats into Borneo 193
Caught in the Web of Life. 194
How Many Interdependencies 195
We're Just Babes in the Woods. 196
Lunch Bag Ecology - Part I 198
Lunch Bag Ecology - Part II. 199

Insects, Flowers, and Pollination. 201

Teacher Information - Pest Management. 203
Flower Power - Part I. 204
Flower Power - Part II 206
Magic Spots. 208
Garden Puzzle. 210
Plant Architects 213
I Need My Space. 215
Poisoned Darts 217
Earth, Planet of the Insects 219
Charts of Beneficial/Harmful Insects 221
Insect Anatomy or Make No Bones About It 223
Bitecycle. 225
Who Lives Here?. 228
On Your Mark, Get Set, Get Slimy!. 231
Buggy Diner. 233
Ladybug, Ladybug, Fly Away Home. 235

Energy 237

Energy Detectives. 239
Are You a Loser, User, or Saver of Energy. 241
Big Mac Engery Attack. 242
Eddie Electric and Motoring Mable. 243
Pretzel Hog. 245
Same-O, Same-O 247
Sin City 248
The Great Gearloose Creation 251

Recycling. 253

Circle - Cycle - Recycle 255
The Cycle of Recycle .257
Freeways Full of Garbage 258
Self Survey. 261
A Human Paper Factory. 263
Mysterycycle Guessing Game 265
Recycling at Your School 266

Problem Solving

Communication

you can make it!

The skills of problem solving, communication, cooperation, concentration, and listening form an important foundation for our total curriculum. Much can be gained and learned with students having some strengths in these important areas.

Both indoor and outdoor, active and calm activities are included in this unit. Each activity strives to involve students in practicing one or more of the above-mentioned skills in a fun and novel manner.

Lesson Titles	Recommended Grade Levels
Sinking Ship	3-4
Count Off	2-3
I Just Love Applause	2-6
Lap Game	3-6
Lighthouse	2-4
Knots	2-6
Skis	4-6
Monster Mash	5-6
Six Bits	4-6
Tell It Like It Is	4-6
10-4 Good Buddy	2-6
All or Nothing	5-6
Five Squares	5-6

Special Materials & Where To Find

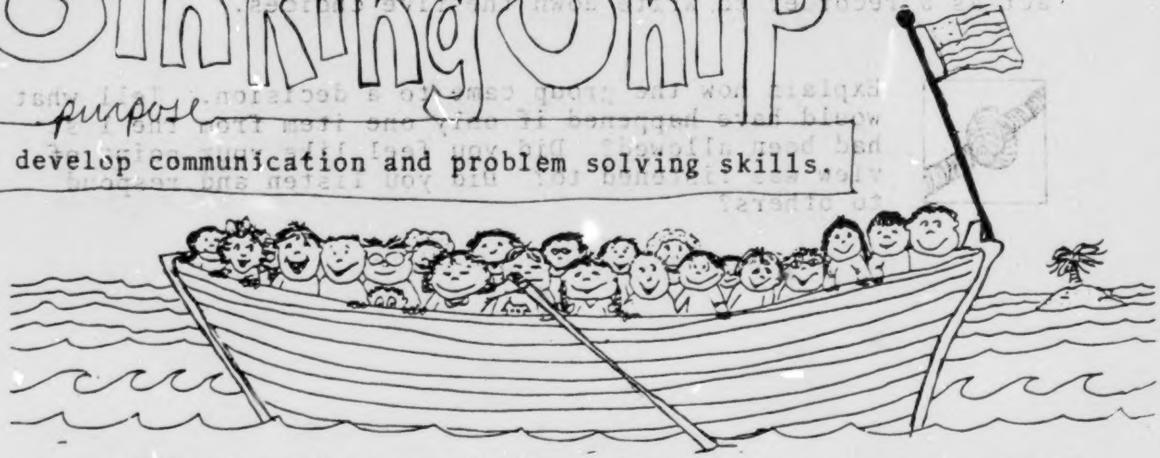
Skis - 2' x 4's from lumberyard. See directions attached to lesson.

*The above material is listed to assist you in locating it. All materials are listed with each lesson and most are readily available.

Sinking Ship

purpose

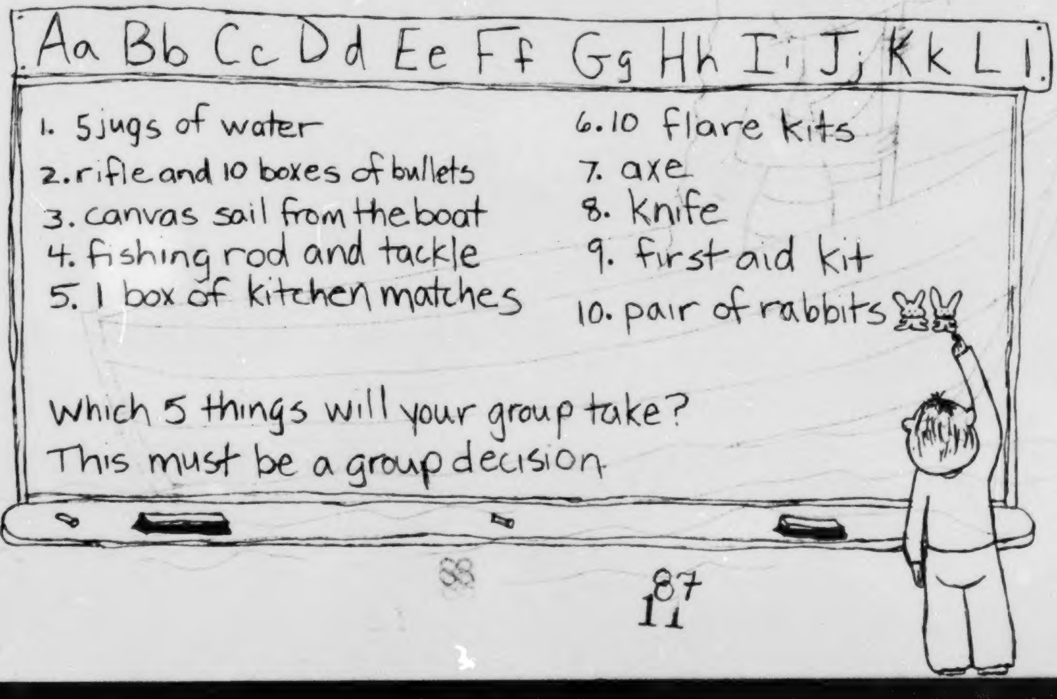
To develop communication and problem solving skills.



This exercise is designed to have students solve a problem in a cooperative manner through the use of a simulated disaster.

Read the following to the class. As a field trip, your group has taken a boat ride to see some islands which lie off the Santa Cruz coastline. The boat is now by a large island. We know that this island is deserted; there are no people on it. We do not know if there are animals on the island or if there is water on the island. From your boat, you can see that there are some trees and greenery on the island. Suddenly the boat scrapes along a large rock which tears a hole in the boat's bottom. The boat will sink in 30 minutes. Fortunately, there is a small lifeboat that you can use to get to the island, but it is not big enough to sail on the open ocean back to Santa Cruz. There is room for all the people in your group and for five things that you can take with you from the larger boat.

On the blackboard write the following list of things found on the boat.


Aa Bb Cc Dd Ee Ff Gg Hh Ii Jj Kk Ll

1. 5 jugs of water
2. rifle and 10 boxes of bullets
3. canvas sail from the boat
4. fishing rod and tackle
5. 1 box of kitchen matches
6. 10 flare kits
7. axe
8. knife
9. first aid kit
10. pair of rabbits

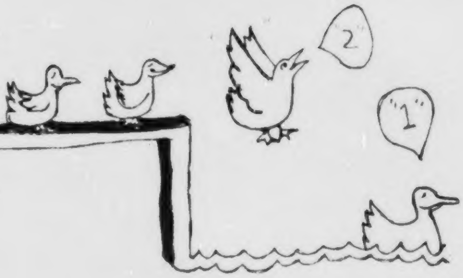
Which 5 things will your group take?
This must be a group decision

MORE

This can be done as a whole class activity, or as a small group exercise. If done as a small group exercise, have one student act as a recorder to write down the five choices.

Explain how the group came to a decision. Tell what would have happened if only one item from the list had been allowed? Did you feel like your point of view was listened to? Did you listen and respond to others?

Count Off



purpose

To develop the skills of problem solving and cooperation.

Materials: cardboard on string for each student, numbered sequentially

. This exercise asks students to physically order themselves according to numbers on their backs.

*While students are sitting at their desks, place a number on their back, face side visible.

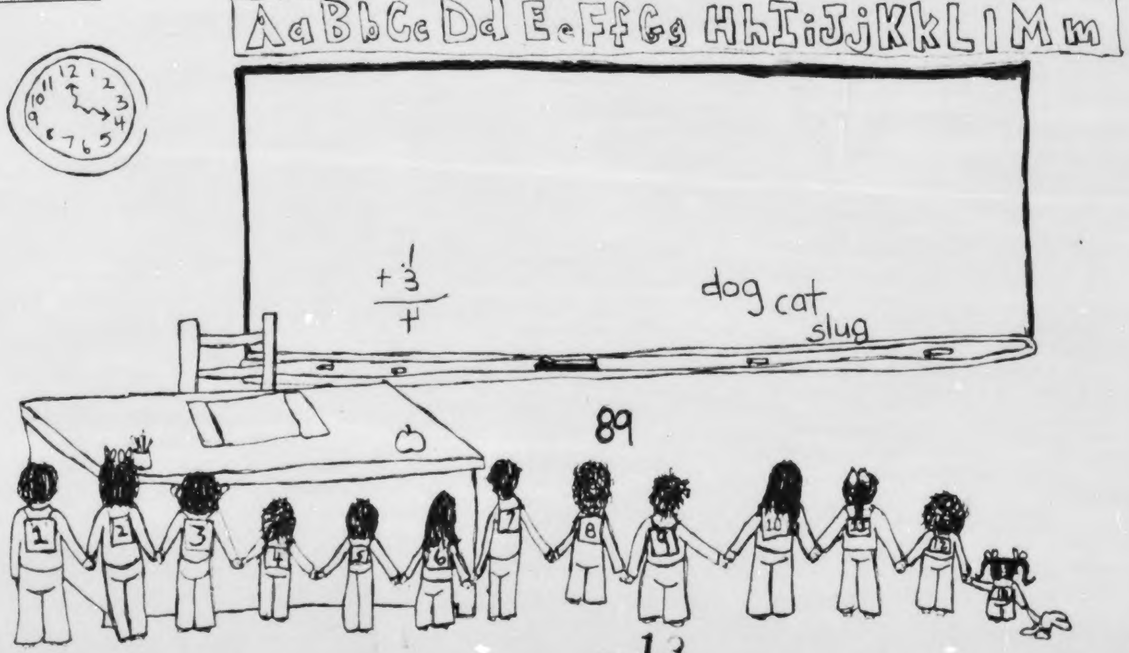
*Students should neither speak, nor look at their own number. This is a non-verbal exercise requiring the group to line up in numerical order.

*Students may lead others to the proper place in line.

*Use the perimeter of the classroom for the playing area, and designate a beginning and an end point.

To inject a greater sense of challenge, inform the class that they are being timed (or ask them if they would like to be timed). Should anarchy prevail after 5 minutes, have everyone "freeze". Remind them that the solution requires cooperation. Give them additional time to complete the exercise.

How many people helped someone else get to the right place? How did you find your place? How did it feel to not be able to speak, and have to solve a problem?



I Just Love Applause

purpose

To develop the skill of communication.

There are many ways to communicate our needs and desires to others. This game asks students to communicate a task without speaking.

*Ask for a volunteer.

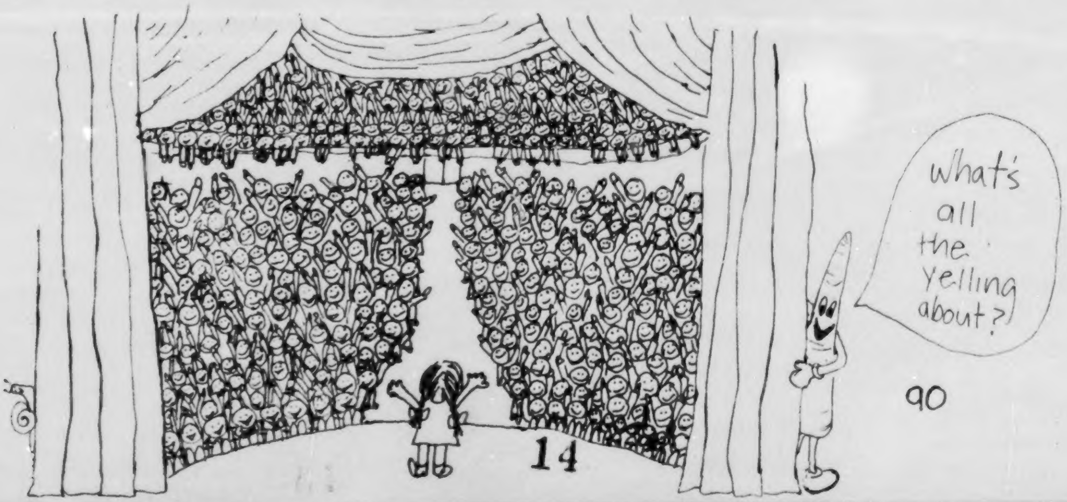
*Have that person leave the room.

*While the volunteer is out of the room decide with the class what simple action you would like the volunteer to perform when they return (e.g., sit down and take their shoes off).

*The class is to communicate this non-verbally by clapping faster or slower as the person comes closer, or moves farther from the desired action.

If you want the person to walk to their desk and sit down, the class would clap if the volunteer began walking in the direction of his/her desk. The class would stop clapping if the volunteer turned away from the direction of their desk. This is similar to the common children's game called Hot and Cold.

Was this an easy or difficult way to communicate? What other methods do we use to communicate our needs and wants? How did it feel when the task was completed? What is feedback? How was feedback used in this game?


What's all the Yelling about?

Lap Game

purpose

To develop the skills of cooperation and group problem solving.

ACTION

This game has each participant playing an integral part of forming a circle of people that is physically connected.

*Have everyone in the group stand in a circle shoulder to shoulder.

*Next have everyone turn to the right.

*Then very gently have everyone simultaneously sit down on the lap of the person behind them. Everyone must do this precisely at the same moment.

*Repeat until successful.

How were each of you important to the completion of the lap circle? What does it mean to cooperate? Can you give examples of people working together in order to accomplish something? What is the opposite of working together?

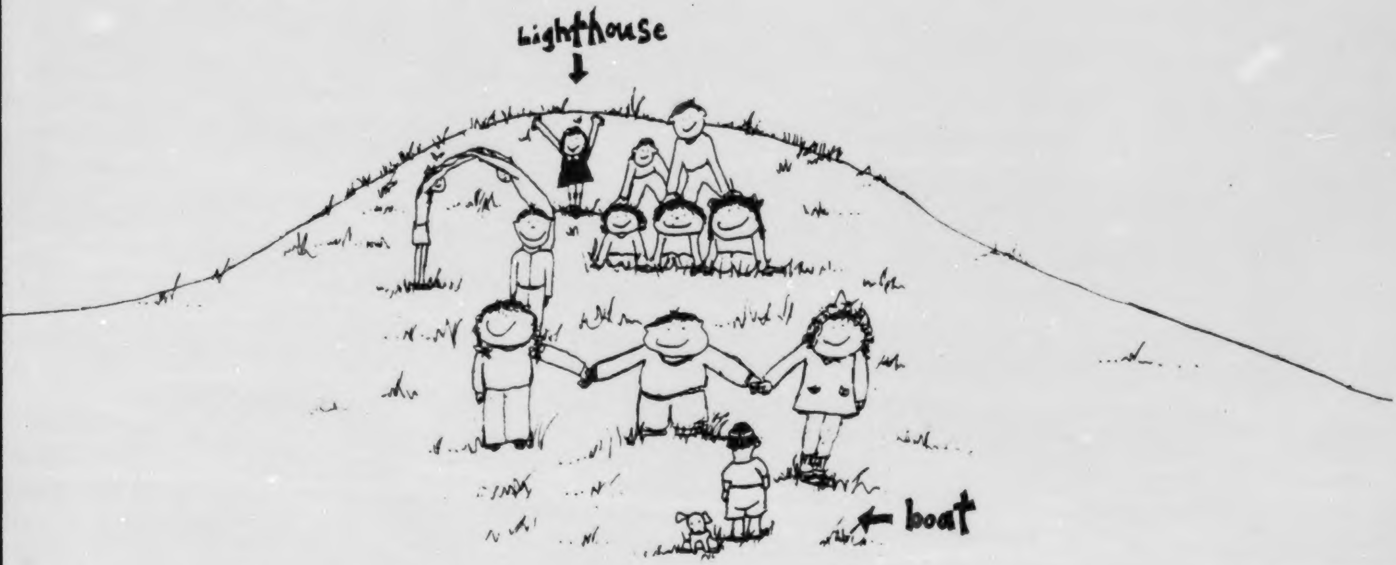
Adapted from The New Games Book, The New Games Foundation

lighthouse

purpose

To develop communication skills.

Materials: blindfold



ACTION

This exercise asks one student (Lighthouse) to verbally lead another blindfolded student (Boat) through a maze of people.

*Ask for a student who feels that they can communicate clearly. They are the "lighthouse".

*Ask for another student who considers him/herself a good listener. They are the "boat". Blindfold this student.

*The remaining students will become obstacles in a bay.

*At one end of the playing area situate the lighthouse.

*At the other end place the boat.

*The remaining students can take their places between the boat and the lighthouse as obstacles in the bay.

*The task of the lighthouse is to verbally lead the blindfolded boat through the obstacles. The lighthouse should remain stationary. The lighthouse should give the boat explicit directions so that she/he will avoid the obstacles.

MORE

The task is completed when the boat safely arrives at the lighthouse. Should the boat hit an obstacle and sink, choose another student to be blindfolded and begin again. The obstacles should remain still and silent.

How did it feel to be the boat? What did the boat have to do in order to stay afloat and reach the lighthouse? How did it feel to be the lighthouse? What did the lighthouse have to do in order to bring the boat in safely? What does "concentration" mean? What does "communication" mean?

Knots

purpose

To develop the skills of cooperation and group problem solving.

This exercise has students form a web with their connected hands. They are then challenged to untangle the knot without speaking or dropping hands.

To form the human knot, give these instructions to the group:

*Stand in a circle shoulder to shoulder.

*Place your hands in the center.

*Close your eyes.

*Grab two other hands, as if shaking hands.

*Make sure that no one holds both hands with the same person, or holds the hand of a person right next to them.

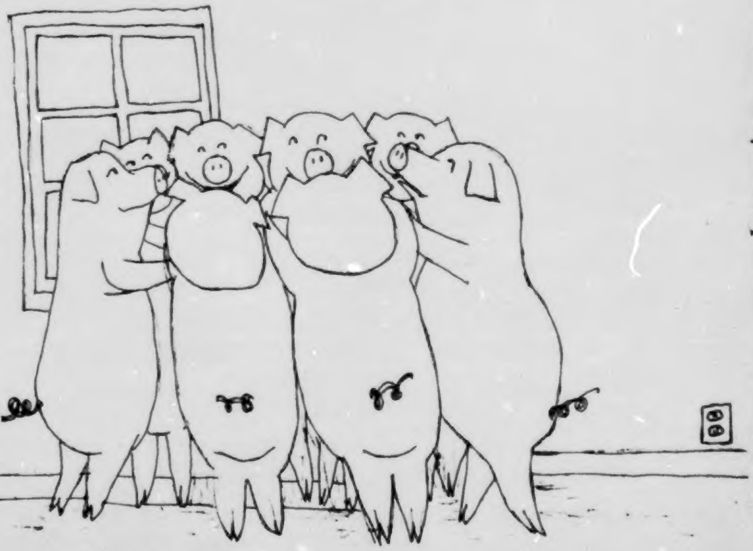
*Now without speaking, or disconnecting hands, open your eyes.

*Untangle the knot without speaking or breaking hands.

Occasionally a knot is too difficult to untangle. If that is the case, try again. A variation on this would be to allow students to speak while untangling the knot.

How did it feel when you were stuck? Did everyone have to contribute to the solution of this task? What does cooperation mean? What is a problem? Can you name some ways people work together to solve problems?

Adapted from The New Games Book, The New Games Foundation



94

Skis

purpose

To foster skills in cooperation and problem solving.

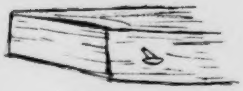
Materials:
- 72 feet of strong cord, 2 2x4's each 10 feet long
- 24 long nails, hammer

This game requires students to work together silently in order to move two ski-like pieces of wood.

After building the skis (see illustrated directions below) have six students stand on the parallel skis - one foot on each ski. Have each student standing on the skis pick up a rope hand hold from the ski. Then give the following directions to the students:

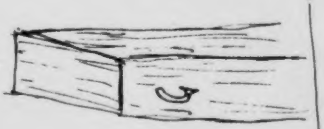
> This is a non-verbal game. That means there is no talking allowed until the end of the game. The object of the game is for the six of you to move the skis that you are standing on a distance of ten feet. You cannot remove your feet from the skis. You cannot let go of the rope that you are holding. You have to work together, without speaking, and move these skis. Sound easy? Remember no talking. O.K., go ahead and begin.

Directions: Ski-making

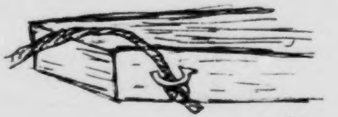
1. 

HAMMER THE LONG NAIL APPROXIMATELY HALFWAY INTO THE 2X4.

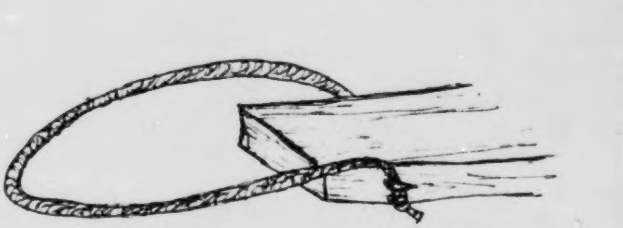
2. HAMMER THE NAIL OVER SO THAT YOU FORM A LOOP.



MORE



3. SLIP THE ROPE THROUGH THE LOOP AND MAKE A STRONG KNOT.



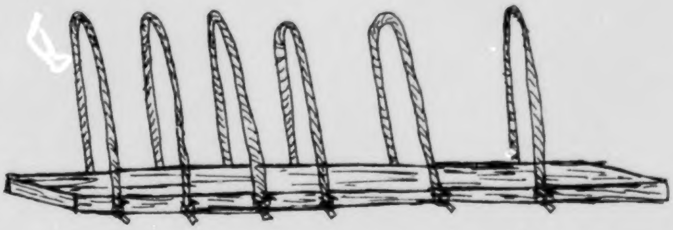
4. DO THE SAME OPPOSITE THE LOOP AS SHOWN

If after 3 minutes, no progress has been made you may choose to allow the group to speak.

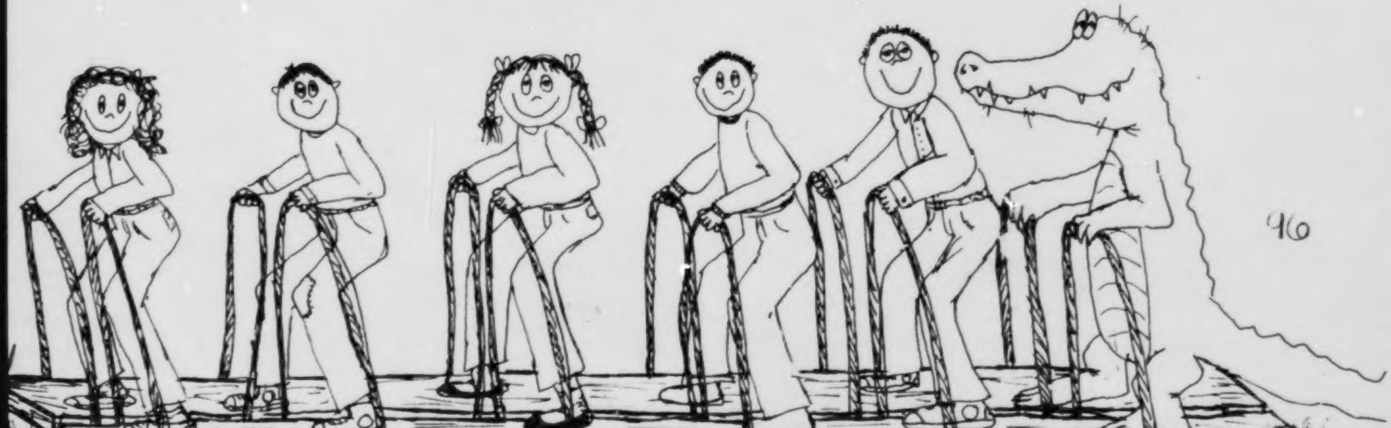
What was needed for this game to work? What could you do next time to better work together?

MAKE 6 OF THESE ROPE HANDLES ALONG THE BOARD
AND YOU SHOULD END UP WITH SOMETHING LIKE THIS!

5.



6. NOW, DO THE SAME WITH THE OTHER 2X4 AND PLAY!



Monster Mash

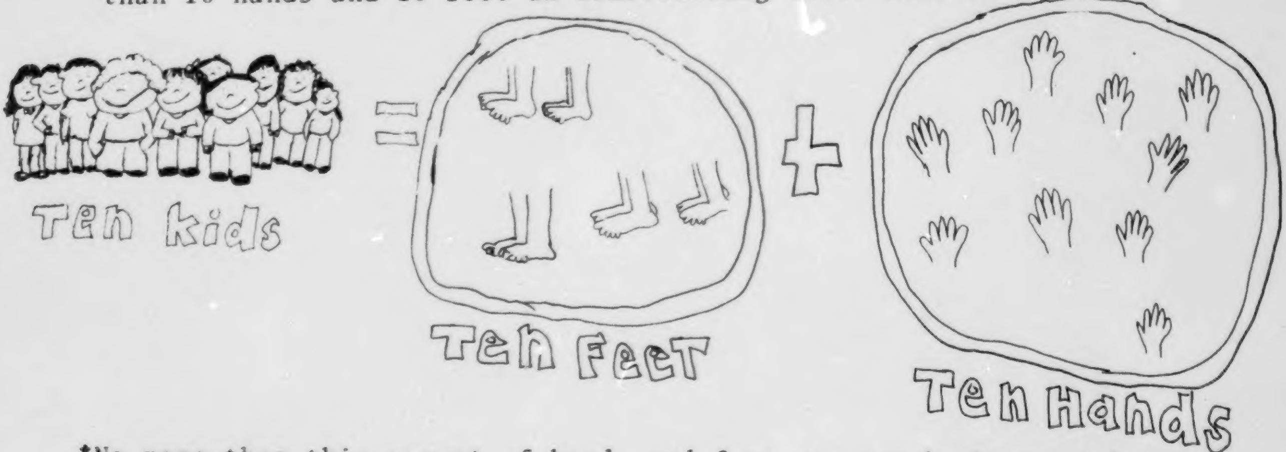
purpose

To develop the skills of problem solving and group cooperation.

This game asks the group to discuss, and then physically solve a problem together.

The group must form a monster all linked together using half the total feet and half the total hands of the group. That number is the number of hands and feet that the group is allowed to use in putting together their monster.

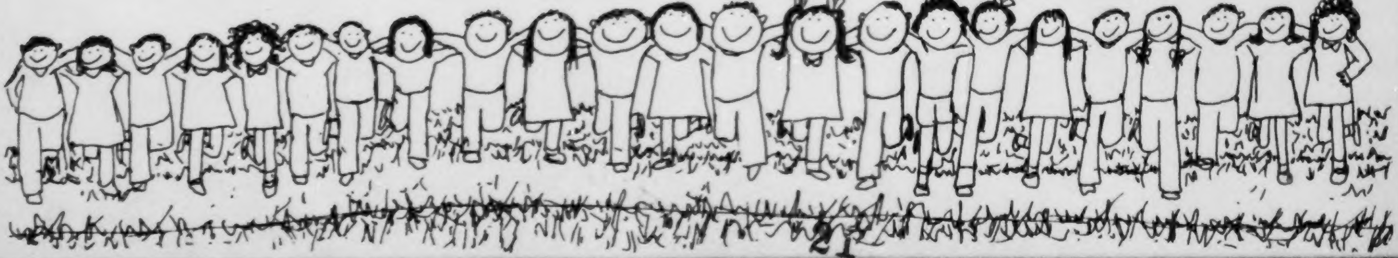
*So say you have 10 group members. The group can then use no more than 10 hands and 10 feet in constructing their monster.



*No more than this amount of hands and feet can touch the ground. No other part of the body may touch the ground.

*Have the group first meet to discuss the problem for 3-5 minutes before actually attempting a solution.

The monster, when completed, must be able to move a short distance. If after 10 minutes the group is unable to complete the task, allow them to use an additional hand or foot. Continue adding appendages until the group is successful. This activity works best with 12 or less participants per group.



Six Bits

purpose

To develop communication and cooperation skills through problem solving.

This game asks students to solve a problem by putting together written fragments of information.

Divide the class into groups of 6, and pass out the "6 bits of information" problem (choose from the problems on the next three pages). Tell the students that there is a problem to solve. They can tell their group what is on their paper or read it aloud; but they must not show it to others.

One of the bits states the question or problem. As the problem solving session progresses, students may ask for help. Tell them that everything they need to know is on the pieces of paper. You may choose to give each group a large piece of paper to assist them in solving the problem.

At some time during the discussion session, make sure the class is made aware of these points:

*The problem could not be solved without the contributions of each person in the group.

*People feel more committed to a session if they contribute by saying something - the earlier the better.

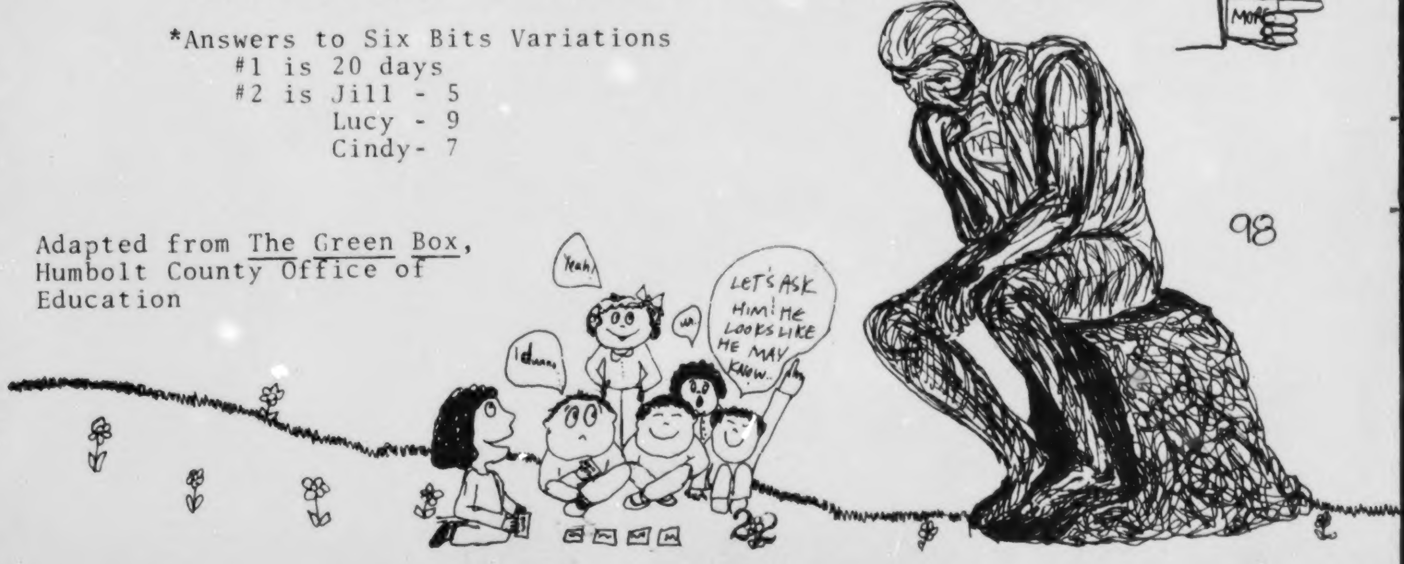
*It's easier to talk to each other in a small group than to talk to one instructor in front of a large group.

*This exercise illustrates that each person in a group brings information and skills that can be used by the entire group to solve common problems. The pieces of paper represented the information and skills that each of you brought to the group.

MORE

*Answers to Six Bits Variations
#1 is 20 days
#2 is Jill - 5
Lucy - 9
Cindy- 7

Adapted from The Green Box,
Humbolt County Office of
Education


Yeah!
Idunno..
uh..
LET'S ASK HIM! HE LOOKS LIKE HE MAY KNOW..

#1 SIX BITS VARIATION (a problem-solving technique)

From
Jerry Parker and
Frank Ferguson

1

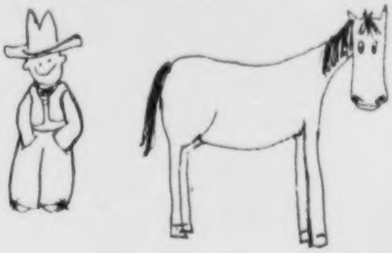
Took more than a week for Slim to round up his horses.

Slim would use division to solve his problem.

2

It took less than a month for Slim to round up his horses.

He rounds up less than 19 horses each day.



3

There are two digits in the number of horses Slim rounds up each day.

Both digits are less than 5.

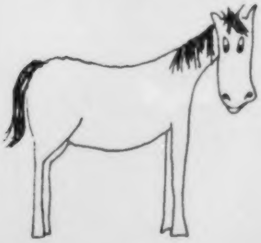
4

PROBLEM: Find out how many days it took Slim to round up his horses.

5

Slim has 260 horses.

He rounds up more than 11 horses each day.



99

6

The number of horses Slim rounds up can be divided only by itself and one.

Slim's horses are all black.

From
Frank Ferguson

#2 SIX BITS VARIATION (a problem-solving technique)

1

Lucy's age plus Cindy's age equals sixteen.

The ages are not even numbers.

2

Jill's age is two less than Cindy's

Diana is older than all the girls.

3

Jill's age plus Lucy's age equals fourteen.

The total of all three girls' ages is the same as three times seven.

4

Find the age of Lucy, Jill and Cindy.

Cindy's birthday is in June.

5

Lucy's age minus Jill's is four.

Jill's birthday is in March.

6

Diana is eleven years old.

Lucy's age is two greater than Cindy's age.

100

BLEG GARBLE BLABBER JABBERYAKYAKHEEHEEHAWHAHOHOBABBLETEEHEEGARBLE MUMBLEMUMBLECHITCHATSHOOTTHEBREEZEYUKYUKYUKYUMYUMMUMBLEHOGWASH MUMBLECHEWTHEFATLADEEDABLABBERBLABBER HMMMMM

Tell It Like It Is

purpose

To introduce students to the concepts of one-way and two-way communication.

This exercise uses verbal direction-giving to study communication.

On the next page is a printed pattern sheet for use with this exercise. Introduce the concepts of one-way and two-way communication and briefly describe the lesson to the class. One-way communication occurs when the speaker does not allow the listeners to ask questions or participate in a dialogue. Two-way communication occurs when the listeners ask questions, give feedback, or take an active role in the discussion.

Explain that the first series of trials will involve only one-way communication.

*Select a volunteer to describe a drawing to the whole class using one-way communication. Be sure that the class understands that they may not ask questions or give the speaker clues concerning his success or lack of it.

*Have the students hold up their drawings and show them the original design that the speaker was describing.

*Ask the students to tell the class what made this task so difficult.

*Repeat the procedure several times.

Select two volunteers and send one to the blackboard. Instruct the student at the board to draw what the second student describes. This demonstrates two-way communication.

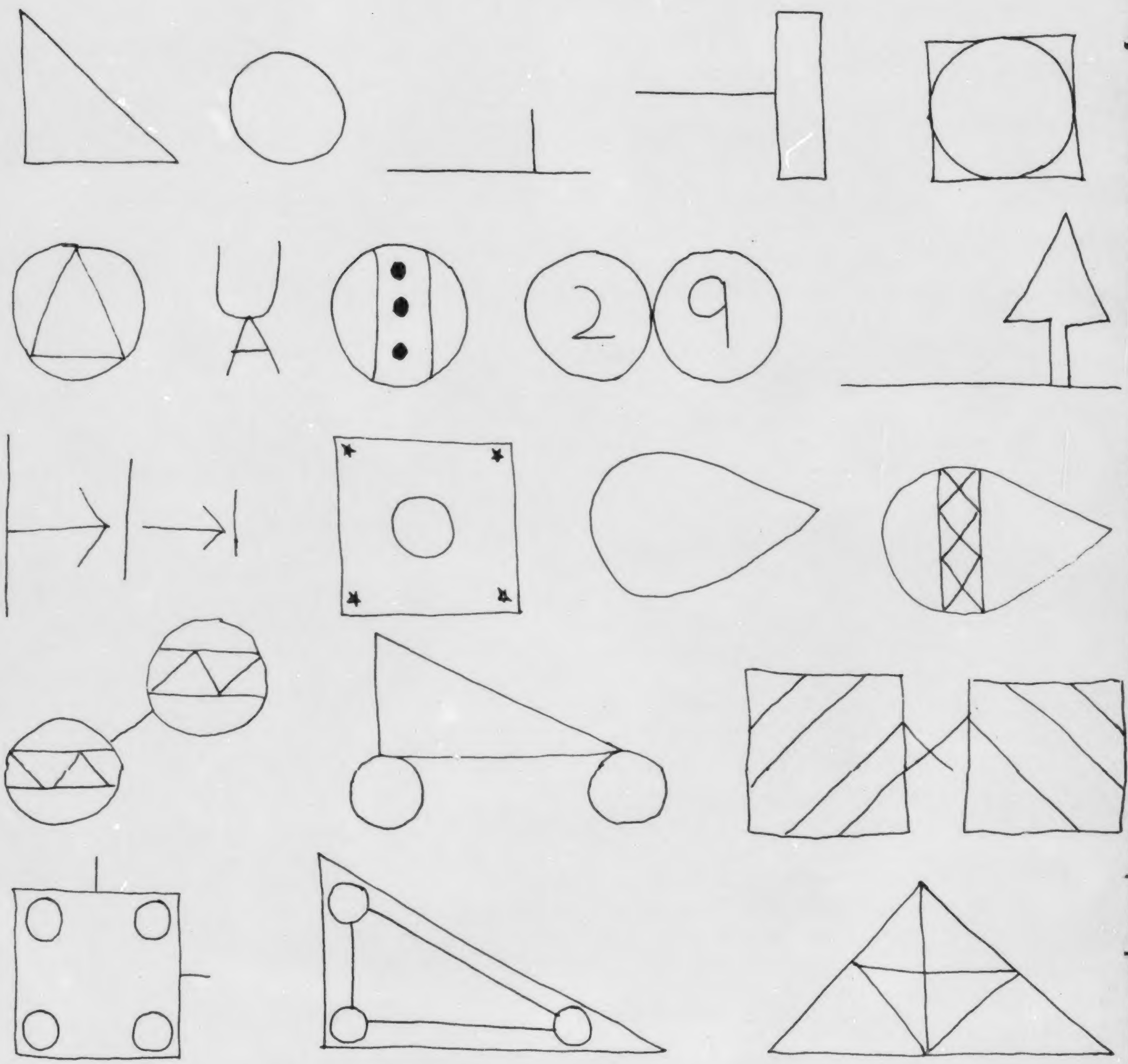
*Give the second student a design drawn on a sheet of paper, and tell him/her to describe the design to the student at the board (from the back of the room to increase the attention of the rest of the class).

*Tell the student giving the instructions that he/she may instruct the student at the board to make changes at any time. Be sure to tell the class that this is a form of two-way communication (the drawing provides the student describing it with information concerning the success of his/her instructions).

MORE

Tell It Like It Is

— suggested patterns —



ALL EARS KING

10·4 Good buddy

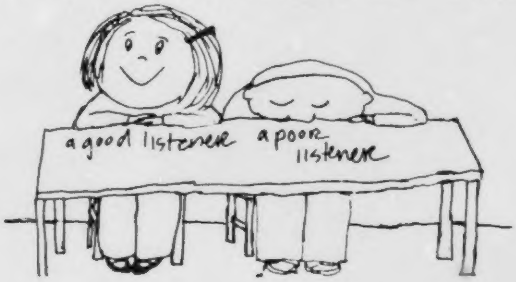
purpose

To practice the skills of concentration and listening.

This exercise uses a discussion format to focus students on listening.

*Start a discussion of special interest to the class (e.g., current events, sports, pets, hobbies, outings).

*After the discussion is underway, interrupt the class and tell them that before anyone speaks s/he must first repeat what the previous speaker has said to that person's satisfaction. Have other members of the class notice if this is an accurate account.


a good listener
a poor listener

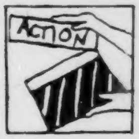
Hold a brief discussion on how the echoing rule affected the class. Hopefully students will recognize that listening is often an active task, not a passive one. Also they may realize they are poor listeners because they become so absorbed in what they themselves are going to say. The exercise also helps students realize the amount of "reading into" others' remarks they do.

I have a pet iguana... named Wilbur...
I like to play horseshoes how 'bout you?
I collect rocks

All or Nothing

purpose

To investigate the process of group decision making.



This exercise forces a group of students to make a decision.

*Get about six volunteers who are willing to pay five cents to be part of an experiment. If necessary, you could encourage volunteers by saying that there is a chance to make some money from the experiment. You may wish to avoid using money. Try asking for volunteers for an unexplained experiment and then providing a walnut or some other object as the prize.

*Have the volunteers form a circle, with the nickel from each placed in the middle. Now explain that the group has ten minutes to decide on who gets the money. The money must all go to one person. No deals can be made to split the money afterward. Leave it completely up to the group to decide how they will award the prize.

*You may want to divide the class and run this activity in four or five groups simultaneously. Compare.

After the decision (the winner should indeed keep the prize), have the class discuss the group's decision-making methods. Often groups will choose luck as their method. Why? Is it fair? Was there any discussion of who needed the money the most?

IN GOD WE TRUST
E PLURIBUS UNUM

Adapted from The Green Box, Humbolt County Office of Education

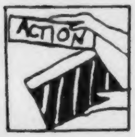
Five Squares

h Ii Jj Kk Ll Mm Nn Oo Pp Qq Rr Ss Tt Uu Vv Ww Xx Yy Zz
aminals
dog
cat

purpose

To develop skills in communication and small group cooperation.

Materials: see preparation below



This exercise asks groups of students to put together a puzzle without speaking.

Divide the class into groups of five. In the case of an uneven total, designate the extra students as official timers. Give each group one complete set of five envelopes (see material directions below). Each child in the group receives one envelope.

Have the students listen to the following rules:

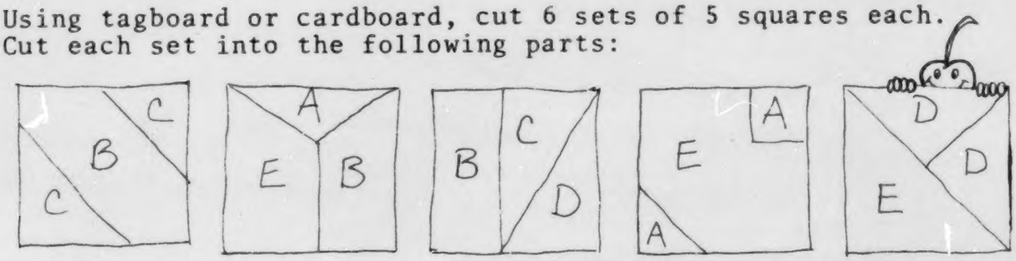
> The object of this experiment is to form 5 squares of equal size.
> Each person in the group must have one square in front of them.
> No member may speak.
> No member can ask, or in any way signal that he/she wants one.
> Members may give cards to others (stress this).

The first group should remain silent until the last group has finished.

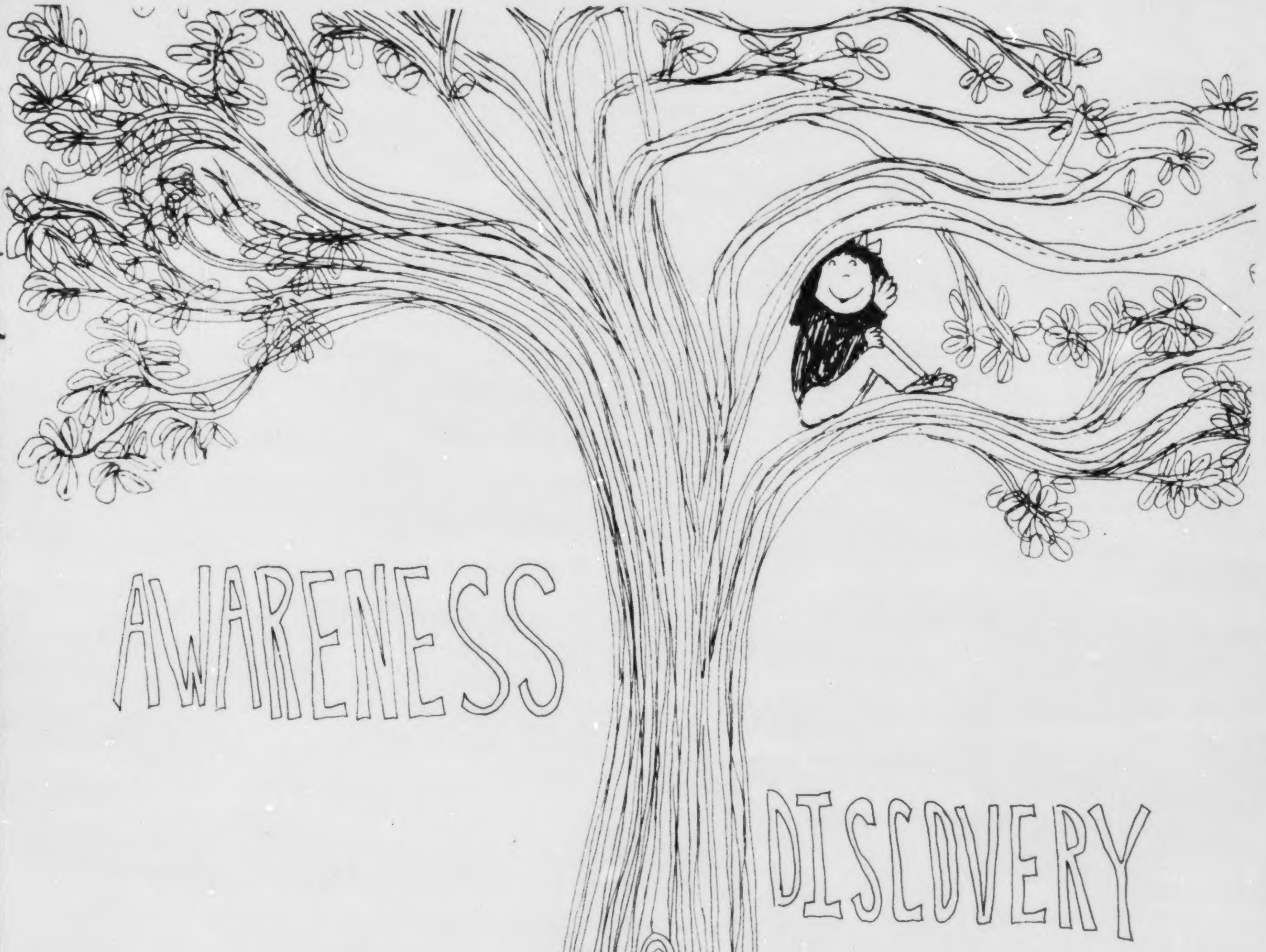
Discuss what happened within the group while doing the task. Was not being able to talk a help or hindrance? What kept you from solving the problem to begin with? What helped you to solve the problem later?

PREPARATION:

Using tagboard or cardboard, cut 6 sets of 5 squares each. Cut each set into the following parts:



Label the parts as they are in the diagram. Label five envelopes with A, B, C, D, and E. Put all the "A" parts in the "A" envelope. Put the "B" parts in the "B" envelope, and so on with C, D, E. Repeat until you have 6 sets (enough for 30 students).


AWARENESS
DISCOVERY
107

Looking about, exploring and expanding our perceptions is the purpose of the Awareness/Discovery unit. We exercise and begin to fine tune the senses -- our connection with the world around us -- with these lessons. The senses become additional scientific tools in the discovery process.

Lesson Titles	Recommended Grade Levels
Candid Camera	2-3
The Unnature Trail	4-6
Ear-ye, Ear-ye	2-5
Only The Nose Knows	4-6
6 of 1, ½ dozen Of The Other	3-5
Everyone Needs A Rock	2-3
See No Evil, Hear No Evil	4-6
Mystery Powders	4-6
Little Munchkins	4-6
Sharp Eyes	2-4
Burma Shave	2-6
Lost In The Ozone Again	5-6
Big Ears	2-4

Candid Camera

SAY CARROTS

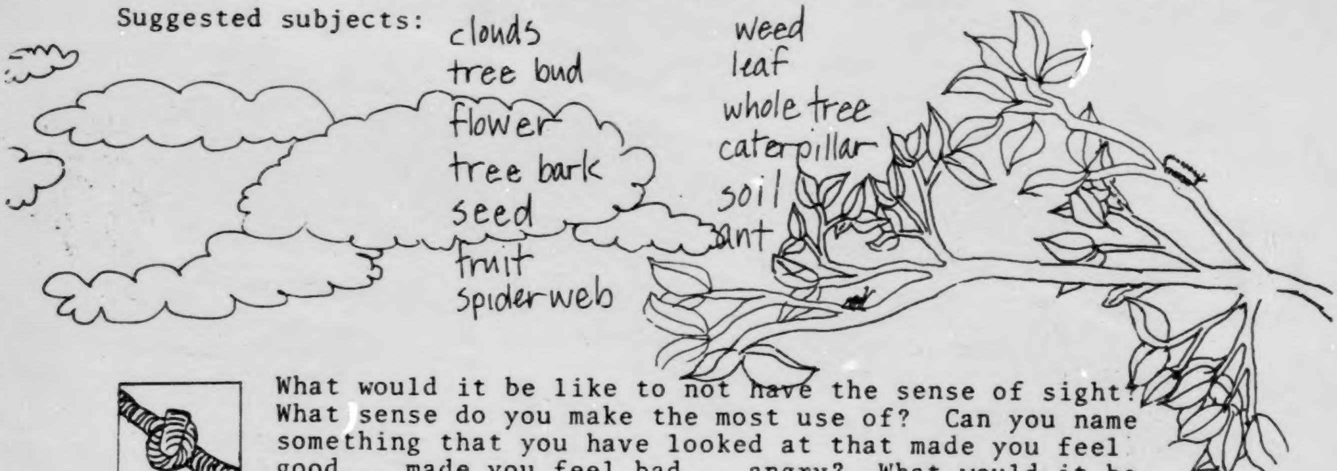
purpose

To develop the skill of observation.

This exercise helps demonstrate the importance of our sense of sight in connecting us with the world we inhabit by having us become cameras.

This is a variation on the basic blindfold walk often used as an introductory lesson on senses. Have students work in pairs. One is the "photographer"; the other is her "camera". The photographer focuses the camera (whose eyes are closed) by pointing it at the subject. Camera must keep eyes shut tight until the photographer exposes the picture by lightly pressing on the camera's shoulder. The camera describes the pictures to the group during sharing time at the end of the exercise. Switch roles.

Suggested subjects:



- clouds
- tree bud
- flower
- tree bark
- seed
- fruit
- spiderweb
- weed
- leaf
- whole tree
- caterpillar
- soil
- ant

What would it be like to not have the sense of sight? What sense do you make the most use of? Can you name something that you have looked at that made you feel good... made you feel bad... angry? What would it be like to have all of our senses taken away?

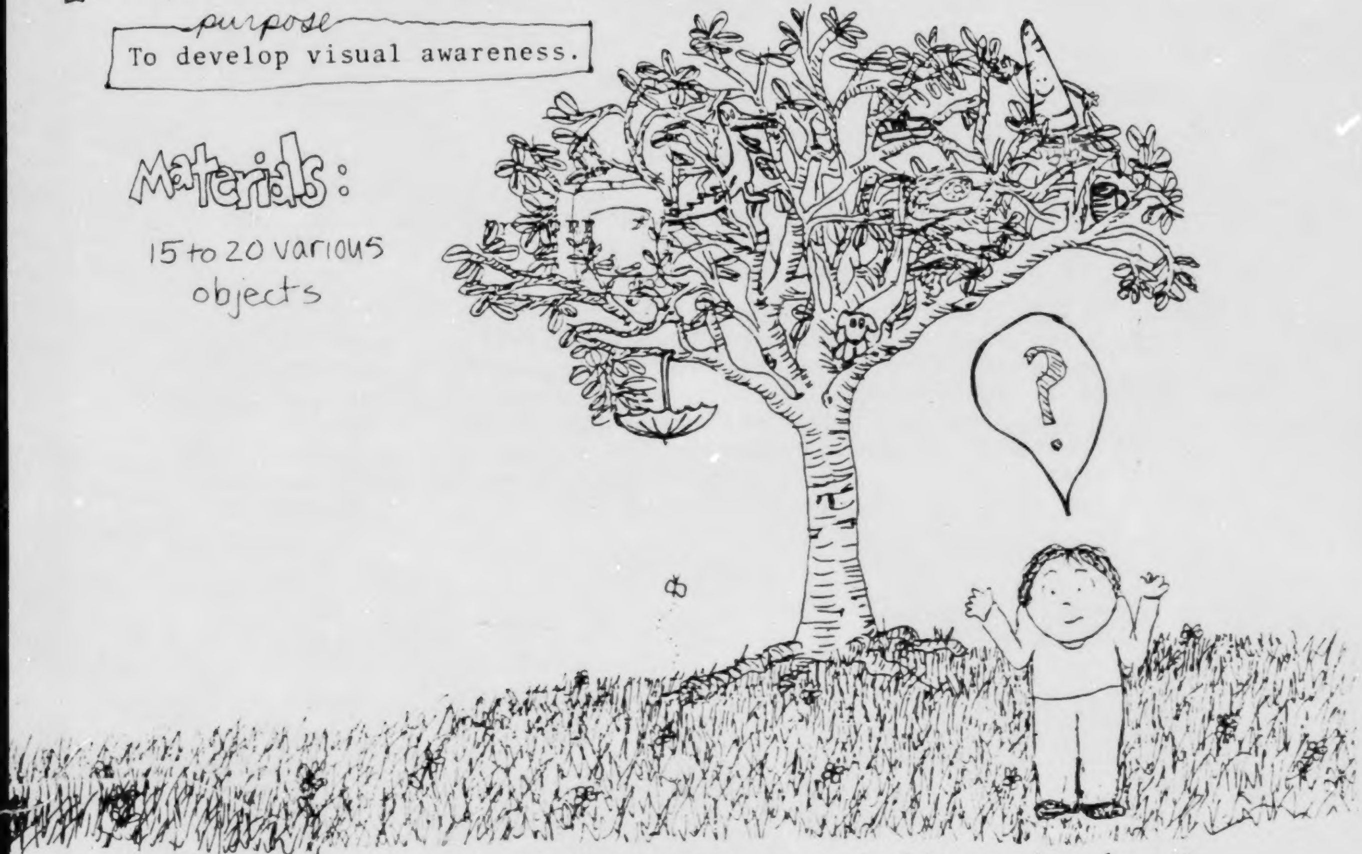
The Unnature Trail...

purpose

To develop visual awareness.

Materials:

15 to 20 various objects



This exercise asks students to find objects that do not belong in a particular environment.

ACTION

Choose a 40 to 50 foot section of back playground or garden site (preferably with one or more trees) and place along it 15-20 human made objects. Some of these should stand out brightly, like flashbulbs or balloons. Others should blend with their surroundings, and therefore be more difficult to pick out. Keep the number of objects you have planted secret. Objects can be displayed from ground level to ten feet high.

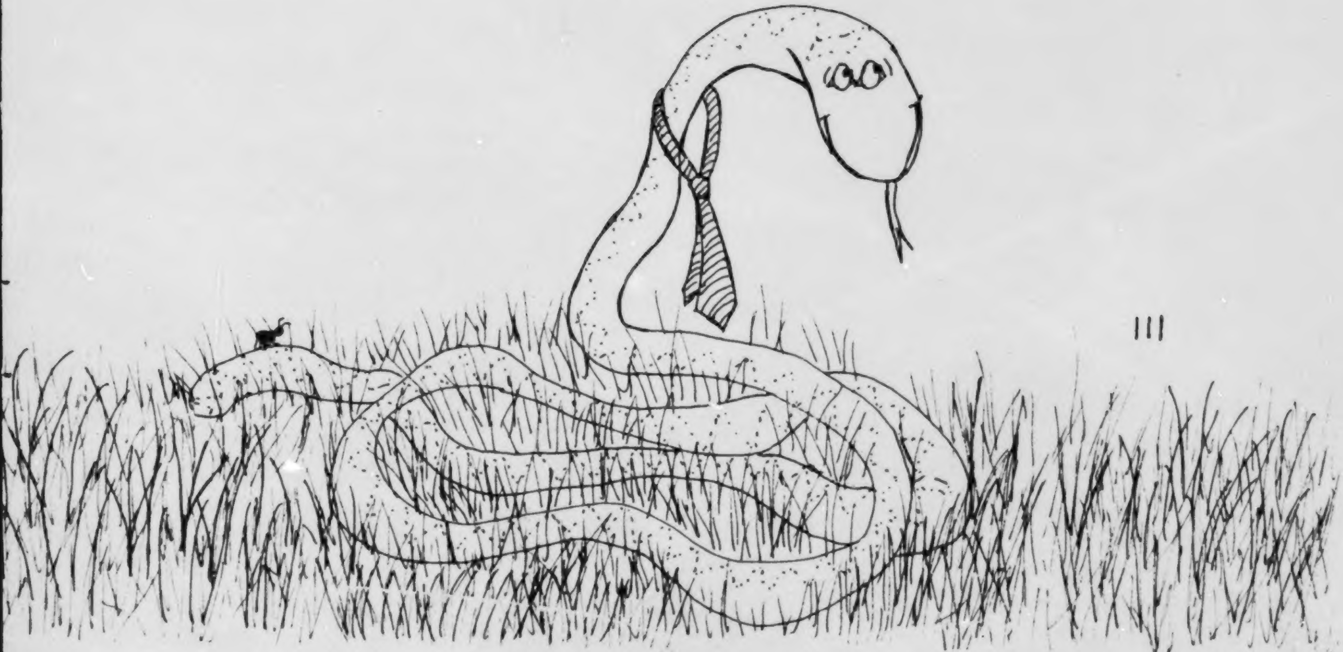
Have the students walk over the section of playground or garden site one at a time, with intervals between them trying to spot (but not pick up) as many of the objects as they can. When they reach the end of the trail, they can whisper in your ear how many they saw. If no one saw all of the objects, tell everyone how many were seen, but that there are still more. Then let them start over. Proceed through as many rounds as the students show interest.

MORE

It is important that students not give away their findings in any way (pointing, jumping up and down, screaming, etc.) to others in the group. This will keep the interest level high.

What was the most difficult object to see? Why? The easiest? Why? What are some things our eyes can tell us about the world around us? Are you more aware of your surroundings when you are in a new place?

Adapted from Sharing Nature With Children, by Joseph Cornell, Ananda Publications



Ear-Ye Ear-Ye

purpose

To develop the sense of hearing.

Materials: various objects and an old sheet

This hearing activity demonstrates the way students use their senses to make judgments about the world around them.

*Tell students that you are going to challenge their sense of hearing.

*Ask for a volunteer to hold the curtain in a way that makes it impossible for any of the other students to see behind the curtain.

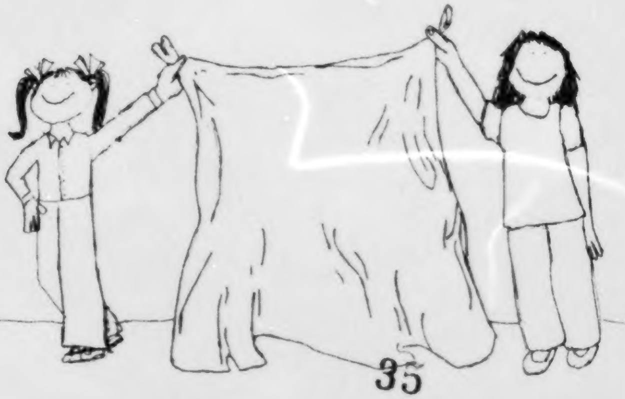
*Tell the class that you are going to drop different objects behind the curtain. Their job is to use their ears to make a judgment as to what object is being dropped behind the curtain.

*Pick one object and drop. Repeat.

*Ask that hands be raised when a student has a possibility to offer. Allow adequate time for all students to consider the problem before soliciting answers.

*Repeat with another object.

What helped you decide what each object was? How has your hearing protected you? What might it be like to live without the sense of hearing?

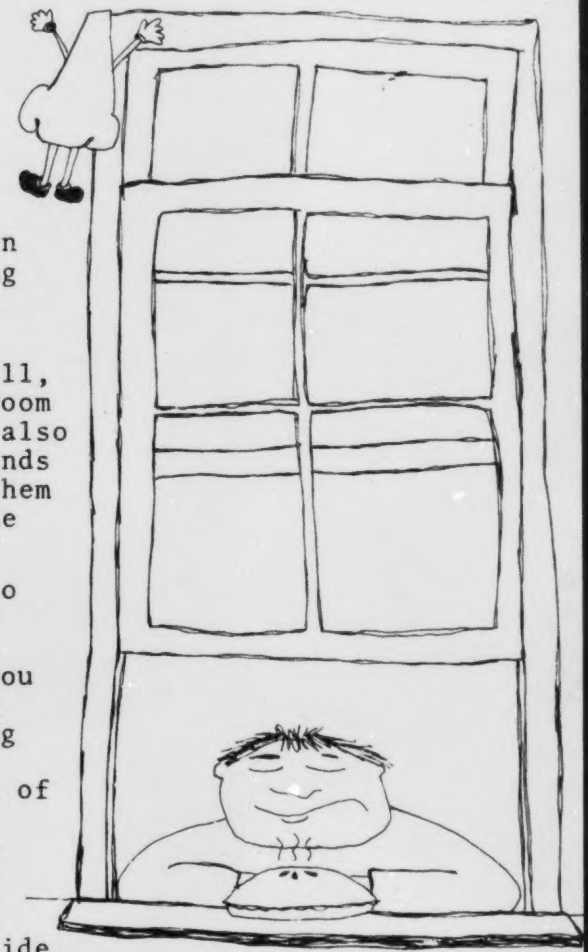


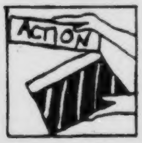
Only the Nose Knows

purpose

To develop the sense of smell.

Materials: BLINDFOLD, CLOTH, AMMONIA, VARIOUS FRAGRANCES





Our sense of smell serves as an important information gathering tool as demonstrated by this mystery smells activity.

With students sitting very still, release in one corner of the room ammonia poured on a cloth. Perfume can also be used. Ask students to raise their hands as soon as the odor is detected. Have them note the progress of the diffusion of the odor through the air across the room.

Discuss what use our sense of smell is to us. What kind of messages does our nose give us about the environment? Can you think of any times when your nose told you something before your eyes (e.g.,knowing what was going to be for dinner; smelling a fire)? What would it be like to be unable to smell anything? Can you think of any animals that would have trouble surviving without smell? Can you name some "good" odors and some "bad" odors?

*Have students take out a scrap of paper and number it 1 to 8 on the left hand side.

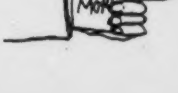
*Pass out the mystery fragrances to the class. Tell them they are smell detectives.

*There job is to use their nose power to solve the dilemma of the mystery fragrances. This should be done individually.

When the students have completed the exercise, discuss the mental connection they made with past experiences that helped them to identify the fragrances. Go over the answers.

Suggested Fragrances

PEPPERMINT
VANILLA
CUMIN
GINGER POWDER
CLOVES
BAY LEAVES
COFFEE
COCOA



Name instances where your sense of smell told you something before your other senses? What would it be like to not have the sense of smell? What happens to your smell when you get a cold?

114

6 of 1, ½ dozen of the other

purpose

To develop a sensitivity to the feel and the appearance of different textures in the garden environment.

Materials: Five egg cartons (Paint the top of the cartons to cover the package design. Across each top write "Touches". On the bottom of each carton, label one half of the carton with one texture, such as "rough" and the other half with the opposite texture, "smooth".)

ACTION

Students, in pairs, search for contrasting textures in the natural environment.

Introduce the activity with a discussion of how we can use our sense of touch.

What parts of your body can you use to find different textures? (Fingers, hands...)

What do many animals use to feel things in front of them? (Their whiskers, noses) How about using your noses to feel things?

Today we're going to explore the garden for different touches. We have special containers for you to go collecting with. Each pair of students gets an egg carton. We're going to collect a dozen touches. On the bottom of the carton are secret words which tell you what touches to collect. Keep these words to yourselves. As you go collecting remember to handle everything gently and to take only small pieces. When you return be sure your collecting boxes are closed so no one will see what you have found.

When the students have returned, redistribute the egg cartons and have students determine the opposite textures that other pairs have collected. (Without looking on the bottom of the carton.)

What things that you collected felt the scratchiest, the softest, the wettest? To find the touches you first looked with your eyes. How did you know from looking, what objects would feel soft? Hard? Squishy? What textures did you find on things that were old or dying? What textures did you find on young plants? What season do you think of when you feel dry, scratchy things? Soft, wet things? Where did you find warm things, cold things?

Adapted from Acclimitization Walks by Kirk Hoessle with Steve Van Matre

Everyone Needs A Rock

purpose
To develop sensory-awareness skills.

Materials: 1 rock per student

Talking to rocks begins as far-fetched, and ends as being an involving and believable exercise for our senses.

*Have students find a rock about the size of two fingers. Ask children to find "their" rock and bring it to a sitting knee to knee circle.

*In the circle ask each child to make a sensory exploration of his/her rock. For example:

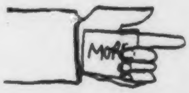
Look for the number of colors in your rock.

Feel for sharp points, smooth places. Is your rock cold against your cheek? Is it a heavy or light rock?

Smell three parts of your rock. Any surprises?

Taste We probably shouldn't taste it, but imagine what it would be like to eat your rock.

Listen to your rock and see if it will tell you something about its life as a rock. Was it always where you found it? Tap your rock with your fingernail. What sound does it make?

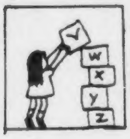


*Have students imagine getting smaller, smaller, and smaller until they are so tiny they can imagine exploring their rock as if it were a small planet. Where would they plant a garden? Is there a bit of dirt on it? Where would they locate a lookout tower? Where would they locate a cave for hiding? Where would they locate a valley to collect rainwater? Where would they locate a house?

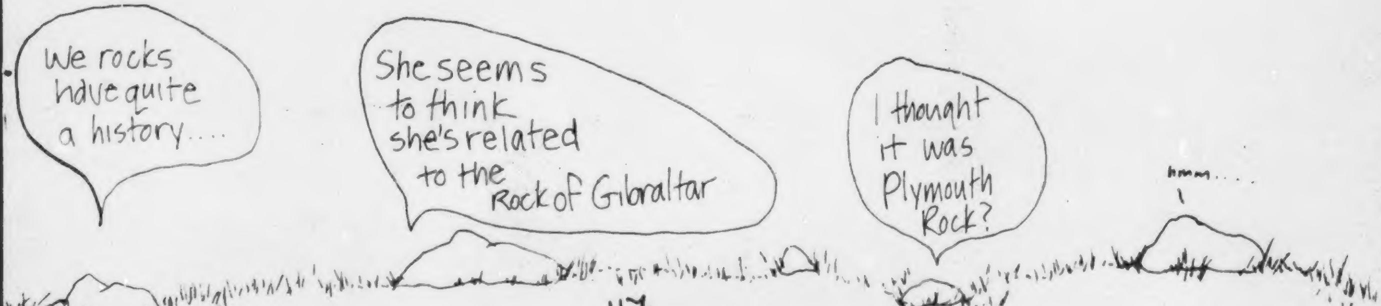
*Collect the rocks, blindfold the children (or have them close their eyes), and redistribute the rocks randomly to the children's right hands. Ask them to feel the rock and when you say "Pass," to pass the rock to their right if it is not their rock. Feel their rocks again, and "Pass," until everyone has their rock. Then take off blindfolds and discuss what children could tell without looking.

*End by having the children disperse to hide their rock somewhere near so that if they came back here they could find it.

List adjectives used in describing the rocks. How many colors were in your rock? How much do you think it weighed?



*Categorize rocks into groups by such characteristics as size, texture, shape, and color.


We rocks have quite a history....
She seems to think she's related to the Rock of Gibraltar
I thought it was Plymouth Rock?
hmm....

See No Evil Hear No Evil

purpose

To develop our senses.

Materials: 4 blindfolds for each group of five students

By focusing on the use of our senses, this game shows us how much information we get from our environment.

*Form a group of five students.

*Choose one person to be the "eye". The other four people are blindfolded and then each person chooses a role: one as the nose, one the ears, one the hands, and one the mouth. Thus all five senses are represented.

*Now form a line with the "eye" in the front.

*The "eye" leads his line to three different objects for investigation.

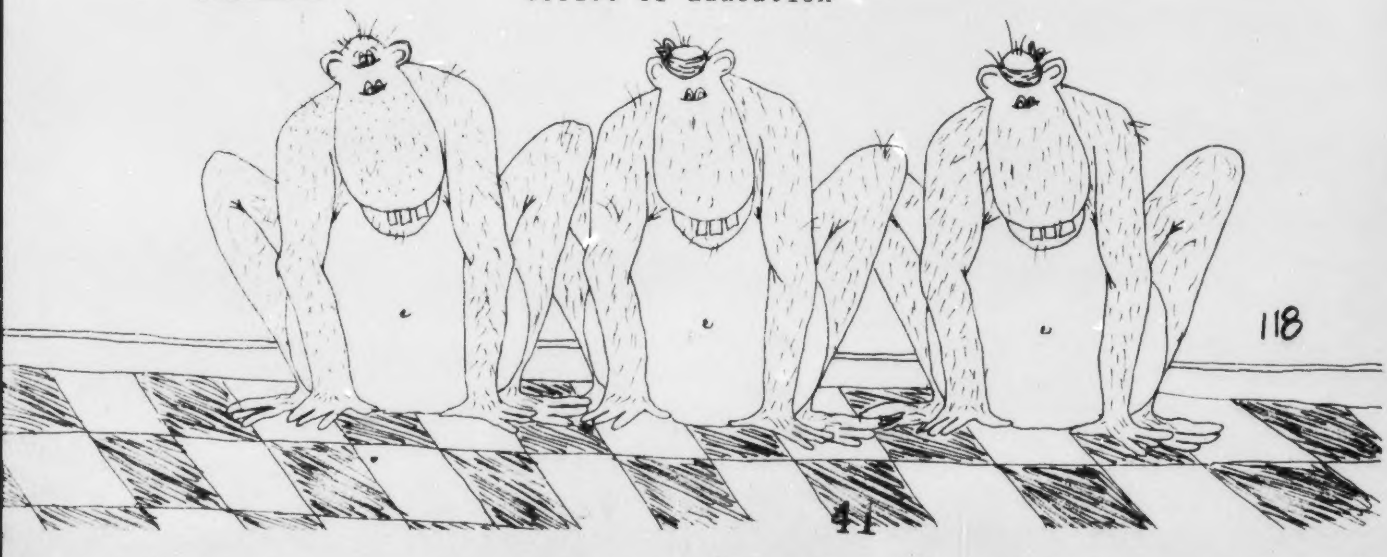
*Each object must be investigated by each person independently in terms of his "sense". The nose smells the object, the hand touches it, and so on.

*Do not discuss together yet. Once everyone has formed his idea of what the objects are, the groups returns home.

How did you feel using only one of your senses? What do you think the three objects were? Why? How important were the other members of the group to you?

Each group can find a way to share what they have discovered (collage, pantomine, verse, etc.).

Adapted from The Green Box, Humbolt County Office of Education

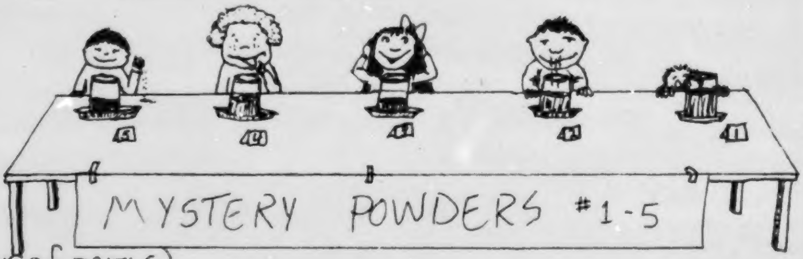


Mystery Powders

purpose

To develop sensory and problem solving skills.

Materials: 6 containers
- flour
- sugar
- salt
- milkpowder
- bakingsoda
- cement (plaster of paris)



This game challenges students to use their senses and problem solving abilities to identify 6 different white substances.

Begin by spacing the 6 bottles (each in a pie tin with a number) in different spots around the room. Give the following directions to the class members:

> Take out a scrap of paper and number it 1 to 6 on the left hand side. You will see, placed around the room, 6 bottles with numbers. Each bottle contains a different white powder. Use your five senses to discover what is in the bottles. If you choose to taste a mystery powder, put only your baby finger in the jar for a small sample and taste. Taste only one sample per jar. Make sure to use all your senses. When you think you know what is in a jar, write the name on your paper next to the proper number. Spend no more than three minutes at each jar. When you have finished, sit down. When most of you are sitting in your chairs, I will end the game. Let's start with five students at each jar. O.K. begin. There should be no talking.

Upon completion ask the students to discuss what it was that helped them solve the problem. At this point you are not interested in the answer. Explore the process of arriving at a conclusion used by the students. List adjectives (without naming the powder) that describe the contents of each bottle. Then list all of the different answers given. Finally, tell them the identity of the secret contents. Leave the cement for last.

End with a discussion of our senses and what they are. Our senses can profit from exercise and concentration. It is important that we develop our senses so that we may make judgments about our environment. Our senses are what connects our bodies to the outside world.

Little Munchkins

purpose

To develop observation and recording skills.

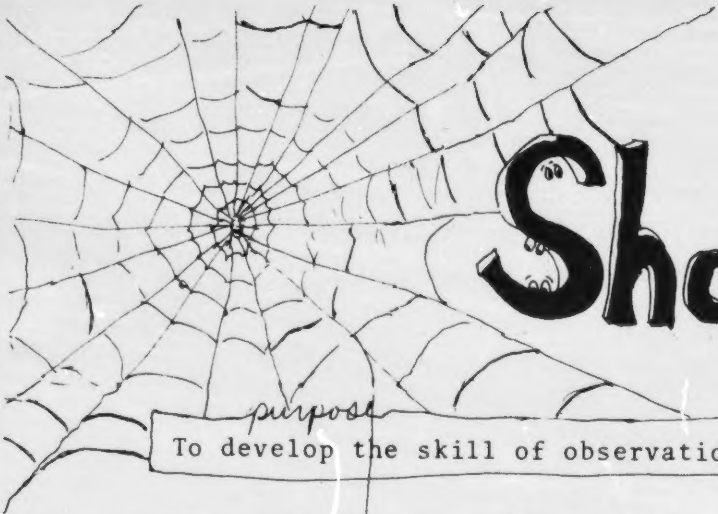
Materials: string, journals, handlenses

By looking closer and recording in this simple activity, we can discover things we have never seen before.

Go on a 100 inch hike. Measure and cut a piece of string 100 inches long for each student. Go to the garden and find a place that might seem like a forest to Tom Thumb. Lay out the string in a straight line, or curve it. Follow the string carefully recording everything that lies along the path. Look closely at the plants on the route to find differences in leaf shapes, edges, textures, colors. You don't need to name them, but show how many of each kind on a chart in your journal. Mount a sample of each (or draw one) on a large piece of paper. Hunt for little creatures and draw them on your chart also. Feel the earth. Is it loose or hard? Include that on your chart. If you find evidence of humans, include that on your chart too. Compare your findings with others. Are there similarities or differences?

Give an example of a texture found on your hike. Tell what it felt like to look closely at a small area. Classify the many things that you observed and recorded.

Sharp Eyes



purpose

To develop the skill of observation.

This game demonstrates how our eyes serve as important information gathering tools.

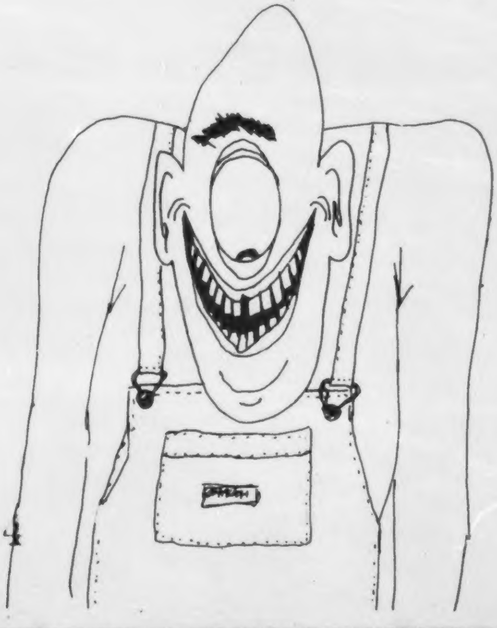
*Have students form two lines facing each other. Each student should be standing directly opposite another.

*Give the pairs time to observe each other, noting such things as color of clothing, rings, other jewelry, how far a sweater is buttoned up, etc.

*After they have had sufficient time, have them turn away and change things about their appearance, i.e. move a ring to another finger, untie a shoe, unbutton a sleeve. Emphasize subtlety.

*Have them face each other again. Can each member of a pair tell what the other changed?

What sense was important in this exercise? Why? How did you detect what change was made?



Burma Shave

purpose

To develop awareness and observation skills.

Materials: 3x5 cards

This self guided set of tasks helps build sharpened perceptions.

After scouting a particular area of the schoolyard or garden, the teacher prints 3 x 5 cards with challenging clues and questions. As children follow, alone or in pairs, the teacher places cards along the predetermined path. Students should remain at least 20 steps from the individual or pair in front of them. The last student picks up the cards.

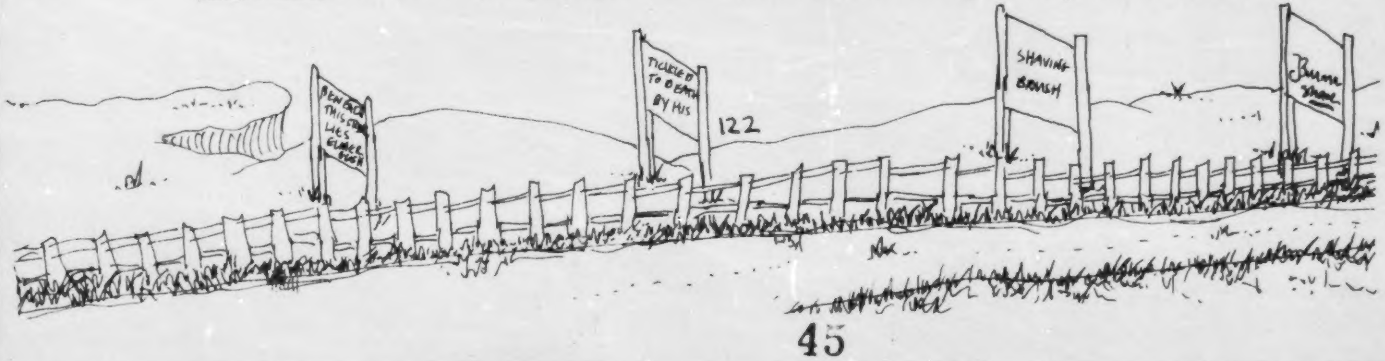
A variation of this would be for the teacher to place the cards prior to initiating the activity. The class can then as a group move from card to card and carry out the task under teacher supervision.

*Your cue cards might read:

Listen for three human-made sounds.
Listen for three sounds not made by humans.
Look for three different animal homes. Who lives in them?
Hot and thirsty? Can you find a drop of water?
Should we build a McDonald's here, so you can have a coke?
How would a McDonald's change this place?
Smell 5 things before the next card.
Run to the next card.
Who do you think lives in this hole?
Can you see any waste of water near here?
Find a seed.
What do you think was here 50 years ago?
Find something that feels rough.
Feel this.

*When everyone has finished, review the cards with the children. Once the strategy is learned, use it again and again in different places. Each time children will get more "into it".

What are some new things you found out about this area? What senses did you use? What would it have been like to do this without our sense of hearing...sight...touch?


BENEATH THIS STONE LIES ELMER BROWN
TICKLED TO DEATH BY HIS
122
SHAVING BRUSH
Burma Shave

Lost in The Ozone Again

purpose

To develop mapping skills.

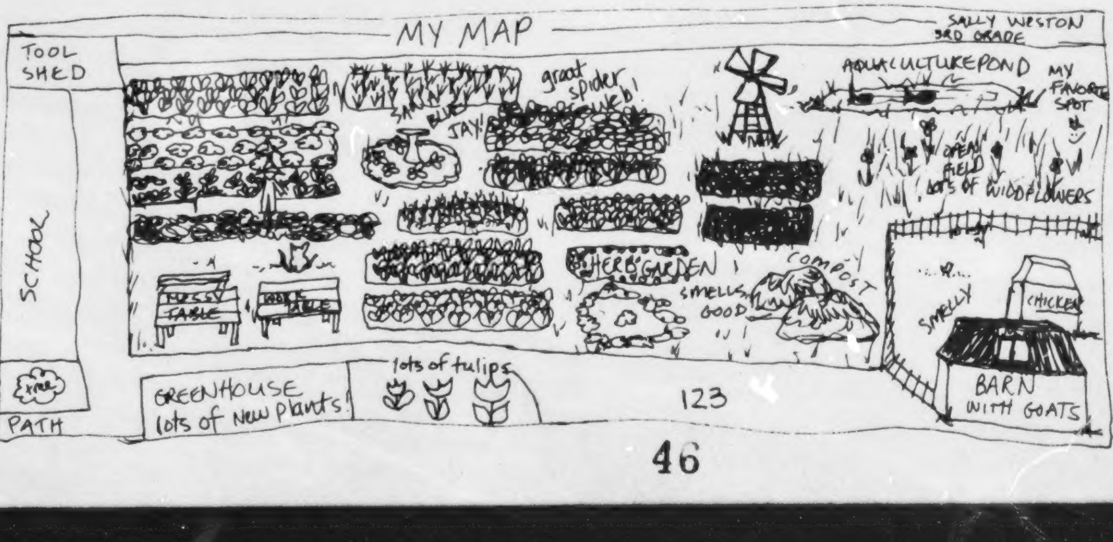
Materials: map outline, pencils

In this exercise we map different characteristics of the school or garden site to help create awareness of the area. This is a chance to encourage careful observation.

Give each student, or pair of students a map of the perimeter of the school or garden site. Have students investigate the site adding details. These maps can be records of their own observations and discoveries rather than a collection of information they have merely checked.

In addition to mapping the location of objects, buildings, fence gates, and the like, this activity can focus on a variety of ways of perceiving an area. For example, people paths and traffic flows for an area can be recorded. The highest, lowest, greenest, brownest, etc. spots can be found and mapped. Students could be asked to determine the places they like the most, and places they like the least. The noisiest and the quietest places could be found as part of a senses map. Use your imagination and explore and map insect homes, or just spider webs. Have fun and discover!

Do people use the land around our school in different ways? What are some uses for maps?


MY MAP
SALLY WESTON 3RD GRADE
TOOL SHED
SCHOOL
tree
PATH
GREENHOUSE lots of New plants!
lots of tulips
123
SAW A BLUE JAY!
great spider web!
AQUACULTURE POND
MY FAVORITE SPOT
OPEN FIELD lots of WILDFLOWERS
MESSY TABLE
HERB GARDEN
SMELLS GOOD
COMPOST
SMELLY
CHICKEN
BARN WITH GOATS

BIG EARS

purpose

To have students concentrate on using their sense of hearing.

Materials: 10 paper bags with ear spaces cut out; 5 different pairs of sound makers; 1 sound maker unlike any other.

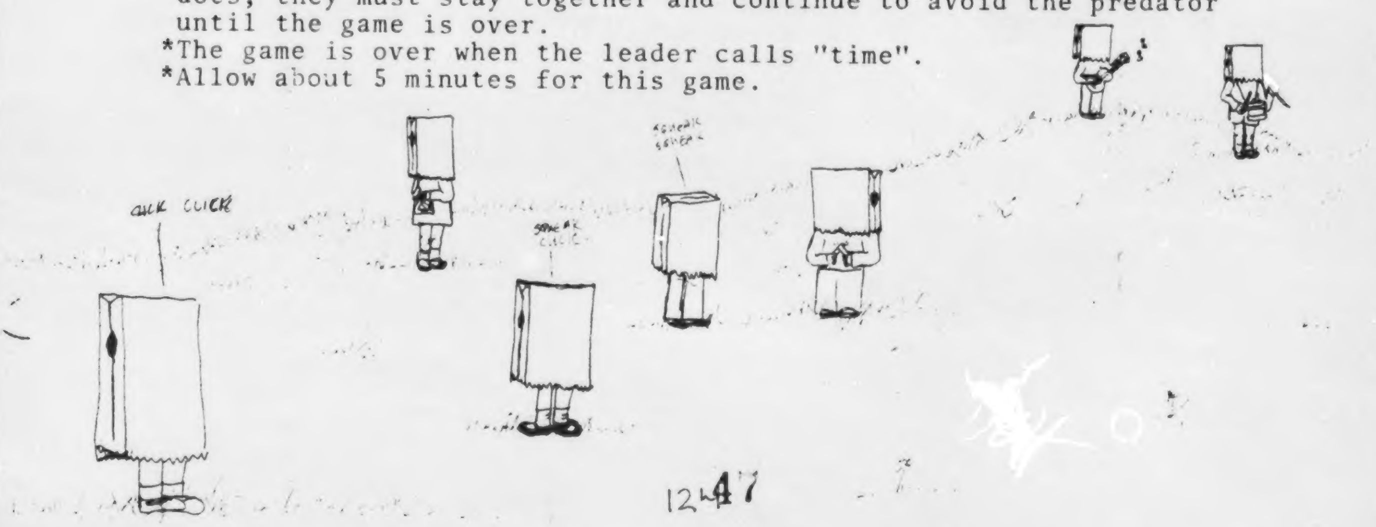
ACTION

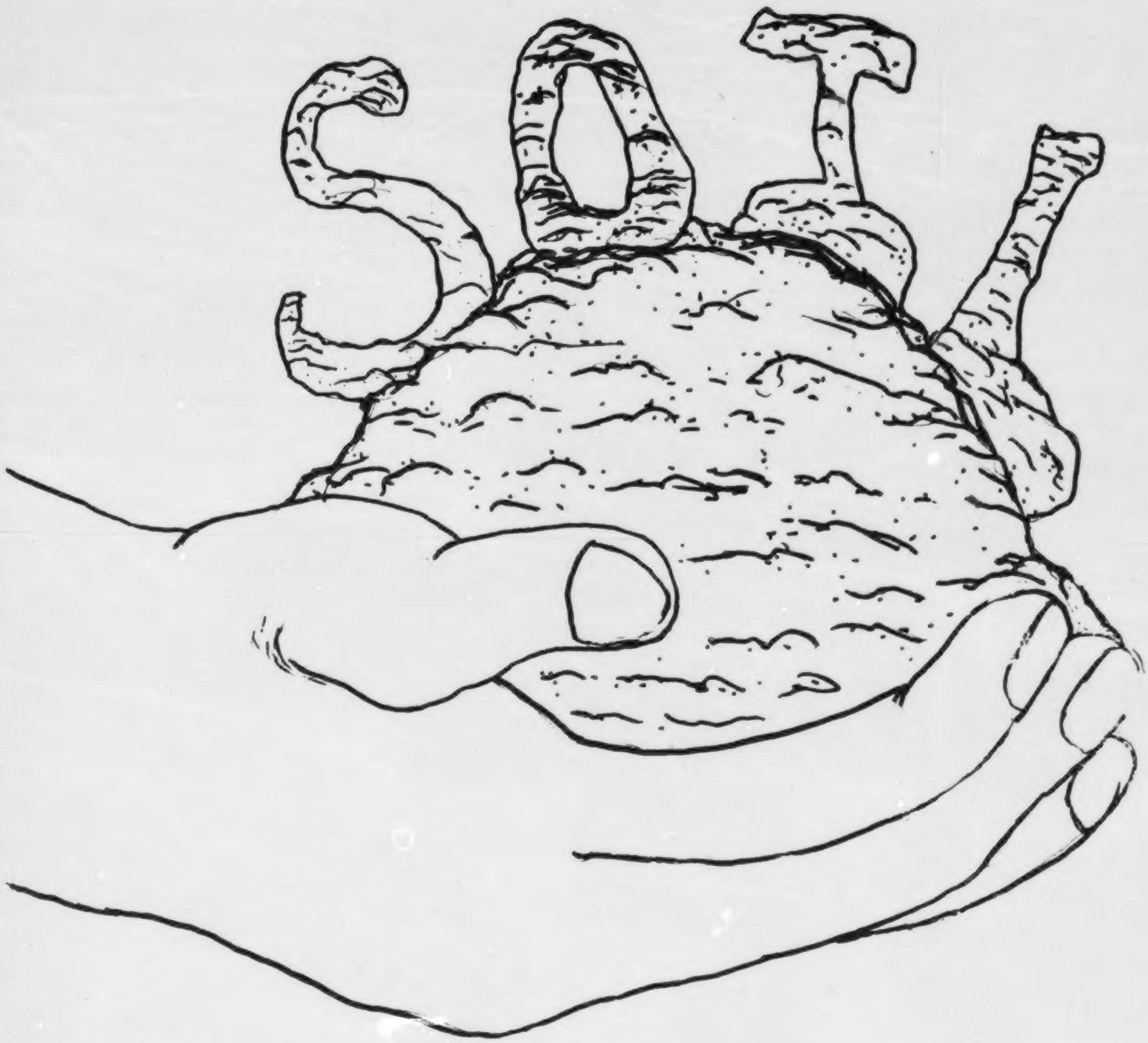
This activity introduces the concept of animal sound communication through a hide and seek game. Secret partners (blindfolded) try to find each other using their sound signals and their sense of hearing.

Ask the participants to imagine they are animals with poor vision or animals active only at night when vision is restricted. What other senses might they rely on to survive? Discuss what is meant by predator (animals that eat other living organisms) and prey (food eaten by predator). Tell the students that they will try to find their partners and avoid being captured by the predator.

Directions:

*Have everyone put on a bag mask or blindfold.
*Give out all the paired noisemakers. No one is to know what each other has.
*Give one student the unique noisemaker. Whisper to this student that they are the predator.
*Spread the players over the playing area.
*Give the signal to sound off. The object of the game is to find the animal that makes the same noise as you do (your secret partner), and to stay with your partner without being tagged (eaten by the predator) until the game is over.
*You can sound off only when standing still, not while moving.
*If the predator tags you, take off your mask and move to the captured area. Predators must be sure the prey know they have been tagged. If partners find each other before the predator does, they must stay together and continue to avoid the predator until the game is over.
*The game is over when the leader calls "time".
*Allow about 5 minutes for this game.




SOIL

From soil sprouts the food that nourishes us, the fiber that clothes us, the wood that warms us, and the materials that shelter us. In this unit we look at the many aspects of soil, from its water holding capacity to its mineral content.

Lesson Titles	Recommended Grade Levels
Behind Door #3 We Have...Soil	2-6
Sensual Soil	4-6
Star Trek	2-3
Living In The Soil	2-6
Soil Doctors	4-6
Water, Water, Everywhere	4-6
The Great And Powerful Earthworm	2-6

Special Materials & Where To Find

Soil Testing Kits - Garden or nursery supply, or order from --
Sudbury Laboratory, Inc., Sudbury, Mass. 01776

Lamp Chimneys - Purchase from hardware or lamp store.

*The above materials are listed to assist you in locating them. All materials are listed with each lesson and most are readily available.

Behind Door #3 we have.....
SOIL!
3

purpose

To explore the composition of garden soil, and determine the quality.

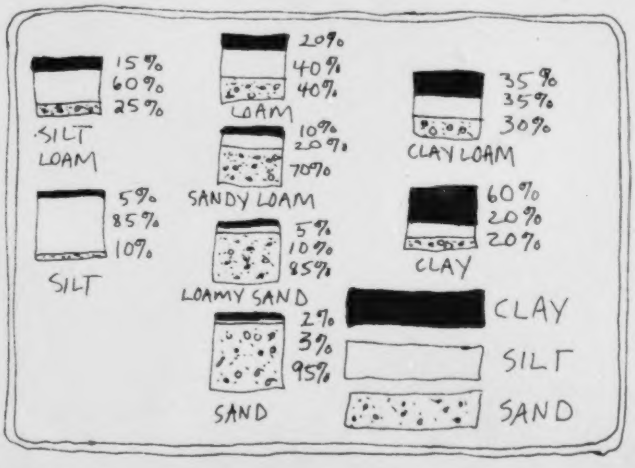
Materials: GLASS JAR, SOIL, WATER

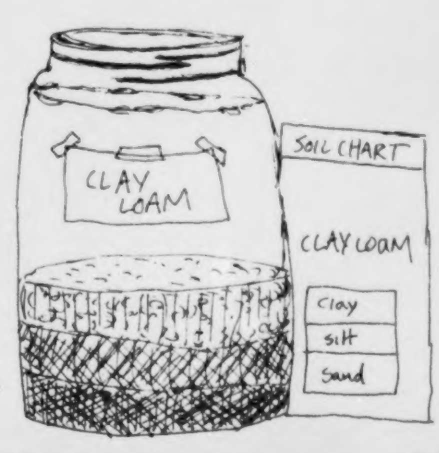
Soil is composed of a blend of various sized particles. The proportion of sand, clay, and silt determines quality.

Gardeners describe soil types in many ways--heavy, light, sandy, clay, loam, rich loam, poor soil etc. Scientists and horticulturists classify soil types by the proportion of sand, silt, and clay particles they contain. Sand, silt, and clay are designations based on the sizes of mineral particles. The texture of the soil is determined by the blend of these various sized particles. Classifying the soils in our garden will give us some indication of the problems we are likely to encounter in working with them--"Soil that has too much clay is hard to work" and "soil that has too much sand dries out fast."

Fill a quart jar about 2/3 full of water. Add soil until the jar is almost full. Screw on the jar top and shake it vigorously. Then let the soil settle. In a short time the heaviest sand particles sink to the bottom and the sand layer becomes visible, but the silt and clay particles will take hours to settle out.

Carry out this same test using soil from different places in your garden. Then chart each of them by marking off the layers on a piece of paper held up to the jar as shown below. Compare each one to our chart. If the particles divide into about 40% sand, 40% silt, and 20% clay, you can call your soil "loam"--a very good kind of soil to have. If your soil falls into other classifications, you may want to add sand or organic matter to change its classification.


15%
60%
25%
SILT LOAM
20%
40%
40%
LOAM
35%
35%
30%
CLAY LOAM
10%
20%
70%
SANDY LOAM
5%
85%
10%
SILT
60%
20%
20%
CLAY
5%
10%
85%
LOAMY SAND
2%
3%
95%
SAND
CLAY
SILT
SAND


CLAY LOAM
SOIL CHART
CLAY LOAM
Clay
silt
Sand

Sensual Soil

purpose

To explore with our senses different kinds of soil.

Materials: Four containers of soil (clay, compost, sand, garden soil), four lunch bags, scrap paper, four pieces of large construction paper.

People often mask many of their sensory experiences and tend to focus on only the visual. Through our exploration of soil, this activity is designed to encourage the students to use all of their senses in discovering qualities of different soils.

Set the tone for a sensory experience. Have your students try to explore soil with new eyes, new ears, new smelling, and new touching skills. The student's mission is to come up with a word to describe each of the four different soils in the boxes (sand, clay, compost, garden soil). Suggest that they can look very closely; smell a clump; taste it with the tip of their tongue; rub it with their fingers near their ears to hear what it sounds like. You might want to play it up and ZAP them all into poets. Explain that the word they choose will later be made into a poem.

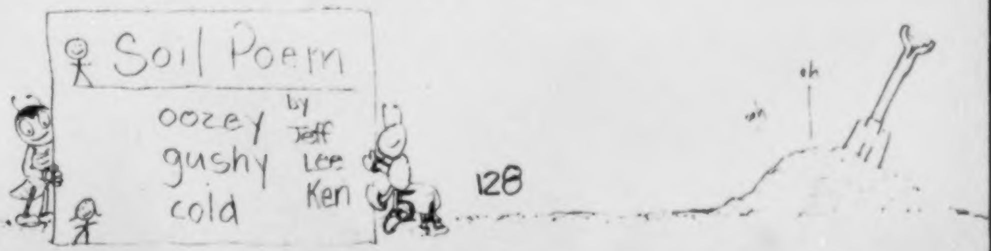
*First, divide the class into four groups. Each group will spend two minutes at each soil station exploring each sample.

*At each station, ask each student to write on a scrap of paper a descriptive word about that sample and place it in the bag.

*After all students have been to all stations, each one of the four groups can take one bag of words and compose a "Soil Poem", using these words, on a large sheet of paper. The poem will be a random ordering of the word descriptions the students have just used. It could even have a title if the students are so inspired. You might want to have one person from each group read their poem to the class.

*Post the poems and attach the proper classification (sand, compost, garden soil, and clay) to each poem. You will learn more about these soils as part of the garden program.

Which soil smelled most strongly? Which felt the wierdest? Which felt smooth and slippery? Which felt gritty and coarse? Which made the loudest sound near your ear? Which tasted like a chocolate milkshake?



Star Trek

purpose

To explore the compostition of various soils and how they differ.

Materials: trowels, hand lenses, journals

Ask the group to imagine that they are Martian scientists aboard the Star Ship Life Lab journeying to the planet Earth. Read the following message from President Gorgo Buehring, the Head of State of the planet Mars:

My Fellow Martians, you have been chosen to make a most important journey. The future of our beloved planet is in deep danger. As scientists, you well know how the planet we love has become so polluted that we are unable to any longer produce our own food. Our astronomers have detected a very faraway planet which the inhabitants call earth. It appears to be lush, green, fertile, and productive. Our computers have been analyzing the reasons for this, and have concluded that the secret appears to be a dead, brown-grey substance which earthlings call soil. It is difficult for us to believe that all of their food comes from this substance. Your mission as scientists is to find this substance, dissect it, and record for our computer each and every ingredient. This will enable our planet to manufacture soil and save us from the tragedy which is about to befall us. Upon landing, divide into groups of three; two dissecters and a recorder in each team. Use the special tool (trowel) our engineers have designed especially for this purpose. Each team should investigate two different soil areas. Remember it is crucial to the success of this mission that each and every substance found in the soil be recorded. Good luck to all of you.

MORE

Upon completion of the task ask teams to compare and contrast the soils they investigated. Ask them to list the qualities of soil. Have the groups verbally list the ingredients they found (e.g., crushed rocks, crumpled leaves, twigs, clay, sand, etc.). Assign ingredients to each team and ask them to return with a small quantity of each. Upon returning, challenge them to use those raw ingredients to manufacture soil (e.g., scrape rocks together, break twigs apart, etc.). When the frustration level of the students is reached, ask them if we can ever make soil by hand? Why not? Each inch of topsoil requires over 100 years to form. Bacteria, fungi, and other living things slowly decompose nutrients such as leaves and twigs recycling them into soil. Soil is alive. Over 100 billion microorganisms live in a pound of soil. Our hands and tools cannot equal the power of the bacteria and fungi. Will our super computer on Mars be able to manufacture soil? How is soil important to earthlings' lives?

Is soil alive? How? Do all materials in soil decompose at the same rate? What do earthworms do for the soil? What would be the result of covering, washing away, and stripping all of our soil?

Living In the Soil

The Secret Life of Plants

purpose

To discover the components of a healthy soil.

Materials: You will need a hard surface to work on, preferably clear ground or pavement. It should be large enough for each child to have room to mix soil on it. Give each kid a hand trowel, and a bucket or gallon pot. You should be situated near a flat mixing or compost area that has piles of compost, topsoil and sand. You will also need flats and seeds to sow.

Read the following to students as an introduction:

Look at a plant. You only see half the story! Each plant travels at least as far underground as it grows above ground. Plant roots are always growing, pushing through the soil, absorbing all the nutrients and water plants need to live. Without this secret underground life, plants couldn't live.

What kind of soil do plants like? It should be porous (that means water can get through it), but still be able to hold some water and nutrients; it should be moist but not sopping; it should have organic matter (like compost) in it, it should be something plants can really sink their roots into!

Let's make a healthy soil.

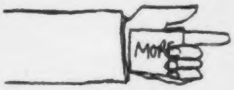
*Ask students to work in pairs and go to different spots in the garden (or in a neighboring orchard, field,--anywhere) to collect a potful of soil with their trowels and buckets. Have them dump it on the hard surface in their own separate piles.

*When they are all reassembled and seated next to their soil pile, ask them to imagine they are a little plant. What kind of soil would they like to grow in? Hard and compact? Light and fluffy? Lots of nutritious food (like compost) or just plain sand?

*Now they should decide how to modify the soil they chose to make it more suitable for a little plant. Have them go get some water, until they are satisfied it is a good soil mix. A test for good soil consistency is: moisten the soil; then take a handful and squeeze it in your fist. When you open your fist, the soil should hold together, but then crumble apart when lightly touched.

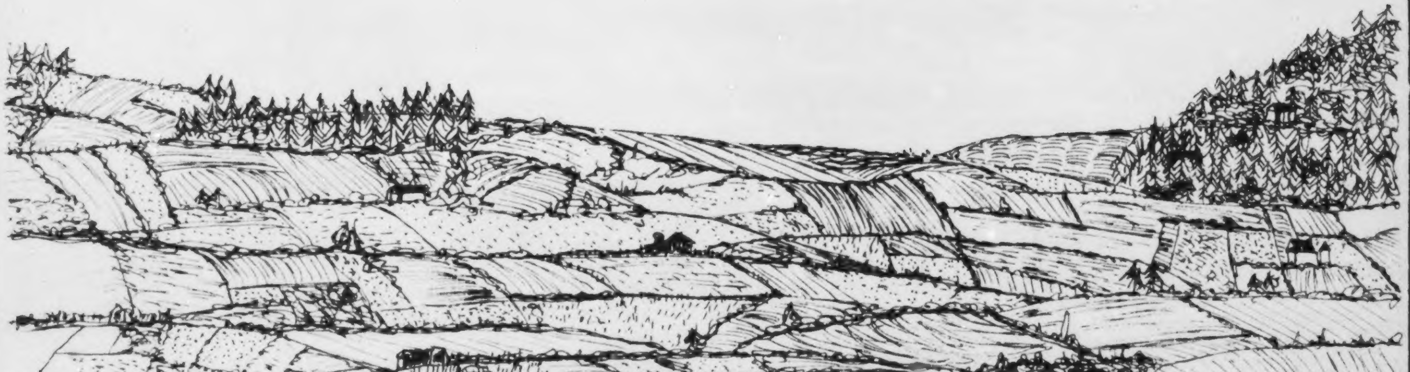
*When they are done, ask them to judge and compare each others' piles. Then discuss as a group the things each pair had to do to improve their soil, and why.

*Now fill a few flats and sow some seeds!



How could you improve your garden soil?

List the reasons why beach sand alone is not a good environment for most plants.



Soil Doctors

purpose

To understand the need of plants for certain minerals to have healthy growth.

Materials: sudbury brand soil test kit,*
soil sample from garden

hmm... looks like you better decrease your nitrogen intake
official MD

Soil contains minerals and nutrients necessary for plant growth. Sometimes shortages of certain minerals exist, and need to be supplemented.

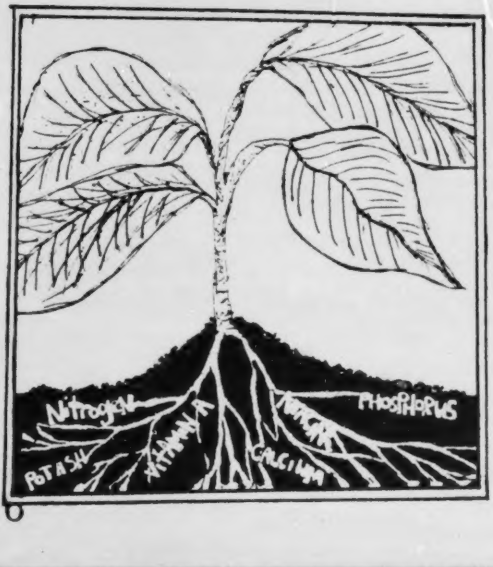
Plants are like people. They need vitamins, minerals and nutrients to live. People get vitamins and minerals in their food. When a person feels they are not getting enough of a certain mineral or vitamin, they change their diet. They may decide to see a doctor who may prescribe vitamin or mineral pills to supplement their diet.

Plants get their minerals from the soil. They manufacture their own vitamins. We can all be soil doctors and find out what deficiencies exist by doing a soil test. There are over 17 minerals needed by plants that are in the soil. With our soil testing kit, we can test for the three very basic and most important nutrients; nitrogen, potash, and phosphorus. Nitrogen is what makes the plant green, and what makes it grow. Potash helps overall strength and disease resistance. Phosphorus is for strong roots. Just as people with deficiencies take vitamins or change their diets, more of these nutrients can be added to the soil in various ways. We will learn about some of these ways when we make compost.

Test as many of the three nutrients as you wish. Follow the simple directions in the test book accompanying the kit. Use the color chart in the kit to assess your results. Record your results in student journals.

Name the three important minerals that we tested for. Why do plants need adequate quantities of these? Name two sources of vitamins, nutrients, and minerals for people.

Test your garden plot. Determine what you need to add. Compost helps to improve the nitrogen; bonemeal the phosphorus; and wood ash the potash. Test again after improving the soil and compare your results.

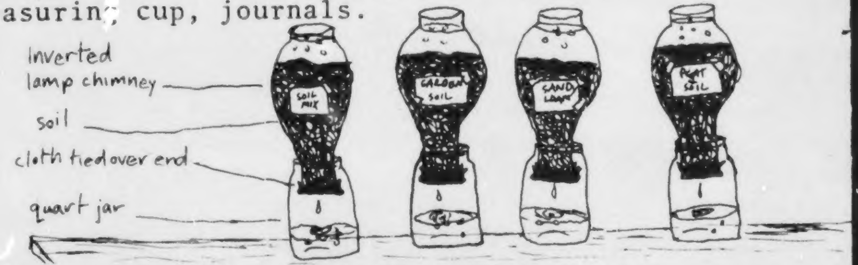


Water Water Everywhere

purpose

To illustrate water holding and drainage capacities of different soils.

Materials: Four lamp chimneys* with various soils, screen, four quart jars, measuring cup, journals.



ACTION

Soil requires both water and oxygen to support strong plant growth.

The ideal soil is a combination of the good points of sand and of clay. Sand provides fast drainage and good aeration, but fails in the water holding department. Clay is tops in water holding ability, but dangerously low in supplying air to the soil. As water fills the spaces between soil particles it drives out air. In soils with a high proportion of clay, water remains a long time in the pore spaces and the roots are deprived of oxygen for many hours. With some plants this temporary lack of oxygen is very damaging. Thus it is easy to drown plants in a clay soil. We can find out about the water retention and aeration of our garden soil by doing the following:

*Have the students pour a pint of water through each of the four inverted lamp chimneys and compare the responses. Ask the students to record in their journals the length of time it takes the water to drip into the quart jars, and how much water comes out from each sample.

*Have the students compare the water holding capacity of the three samples by figuring the amount of water left in the soil after it finishes dripping.

*Ask the students to test the soils drainage ability by:

A) Saturating the soil sample with water until they are holding as much as they can, and then.

B) Adding a pint of water to each sample.

C) Next have the students record the length of time it takes the water to move completely through the saturated soils, stop dripping, and collect in the jars.

*Compare the responses of the Garden Soil, Sand, and Clay with those of the Compost Soil Mix.

*Which soils would you plant a seed in? Why? Which sample could possibly drown your plant? Why? Which sample would you not plant a seed in? Why? Which soil would you not want your plant to be in during a drought?

The Great and Powerful Earthworm

purpose

To illustrate the role of the earthworm as a soil tiller.

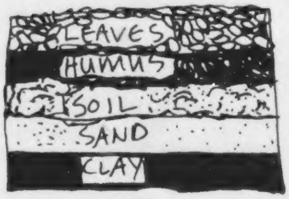
Materials: Two terrariums or glass containers, earthworms (you can collect them from your garden), clay, sand, soil, leaves.

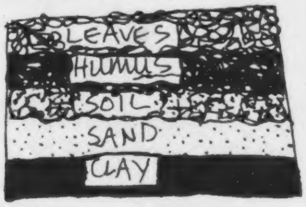
Read the following to students as an introduction:

Can you imagine eating your own weight in food every day? That's what the earthworm does! The earthworm improves the soil by eating it. When the food passes through the earthworm's digestive system it is changed into a material that plants especially like. The earthworm then deposits this recycled organic matter in the form of soft pellets called "castings". These castings are good fertilizers for the soil.

Let's watch these great and powerful soil tillers at work!

*Set up two containers as shown in the drawing:





*Place worms in only one of the containers. Keep the soil of this container slightly moist.

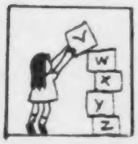
*Describe and draw pictures of the soils of both containers. Ask students to predict what will happen to the soils.

*Cover the worm container with black cloth or paper. Allow air holes for breathing.

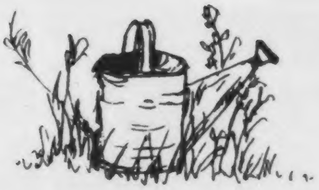
*Remove the black cloth daily over the course of two weeks to observe the effect of earthworms on the soil. Can you see their tunnels? They let in water and air needed by plants.

*Compare the soil in the two containers. How is the earthworm like a tiller? How is it able to recycle materials in the environment?

*Return your earthworms to the garden, making sure they're covered with some soil. Now you can appreciate the incredible job these tiny creatures do!



Hold an earthworm race! Put your earthworms in the center of a circular piece of paper. See which one crawls out of the circle first!



GROWING

The mysteries of growing, beginning with the basic ingredients of life, are the focus of this unit. Lessons are included on plant roots, seeds, and sprouts. The reaction of plants to various environmental cues such as light and gravity are demonstrated. Experiments illustrating the response of plants to environmental stresses such as overcrowding and cold are also included. Most can be done inside your classroom.

Lesson Titles	Recommended Grade Levels
Spaceship Earth	2-6
Big Mac Attack	2-6
Seedy Character	2-4
Adapt-a-Seed	4-6
Samson And Delilah	2-6
It's Getting Stuffy In Here	2-6
Luna-Seeds	4-6
Lotus Seeds	2-6
Growing, Growing, Gone	2-6
Glass Seed Sandwich	4-6
Let's Get To The Root Of This	3-6
Making And Using Root View Boxes	Teacher Information
Run, Root, Run	4-6
Let's Get A Handle On This	4-6
Which Way Did It Grow	4-6
Plant Sweat	4-6
Room To Live	3-6
Seed To Earth	3-6
The Big Sleep	3-6

Special Materials & Where To Find

Big Mac Poster - Ask at your local MacDonald's or fast food chain.

Root View Box - See directions in unit.

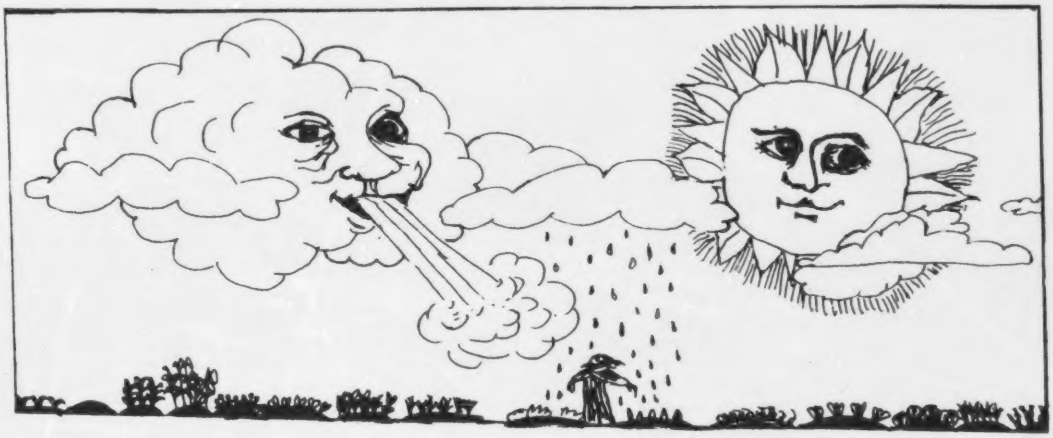
*The above materials are listed to assist you in locating them. All materials are listed with each lesson and most are readily available.

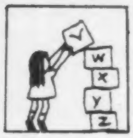
Spaceship Earth

purpose

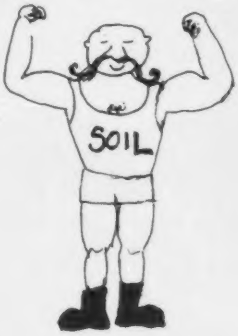
To identify the four basic necessities of life: Air, water, soil, sun.

At a water faucet in the garden, have the students cup their hands together and scoop up water and soil. Tell them that they are holding in their hands the four basic ingredients necessary for all life to exist. Can they name these? What would life be like without any one of the Big Four?

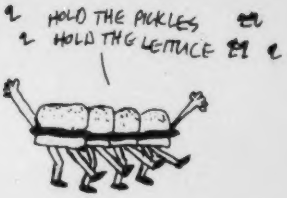




You can try this variation in the classroom. Put in a box a bottle of water and a clear plastic bag filled with soil. Holding the closed box in front of the class. Ask the students to identify three of the four essentials of life held in the box. The fourth, sunlight, enters when the box is opened.



Big Mac Attack


HOLD THE PICKLES
HOLD THE LETTUCE

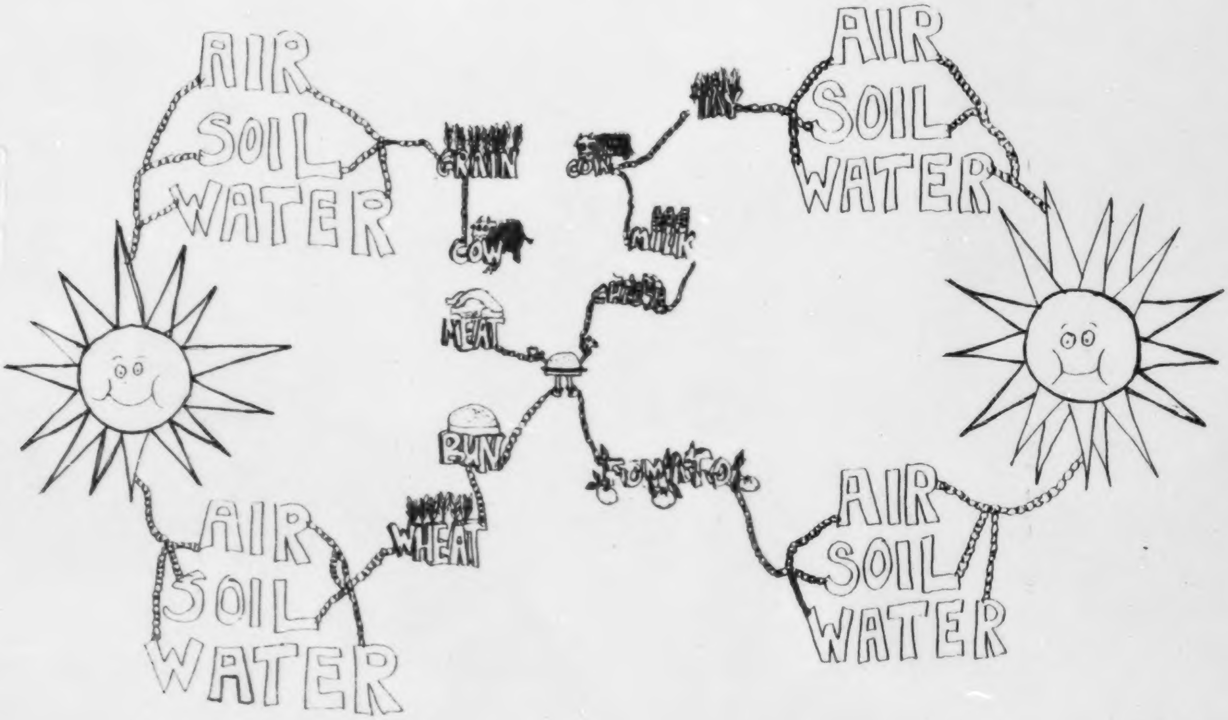
purpose

To illustrate the importance of air, water, sun and soil to life.

Materials: BIG MAC POSTER*

This activity draws connections between a common fast food and the "Big Four" essentials of Life: air, water, sun, and soil.

Design a Food Flow Chart by taping the Big Mac poster to the center of the chalkboard. Draw a rough sketch if a poster is unavailable. Using the chalkboard, help the students trace the origin of the major ingredients (meat, bun, cheese, tomato) of the Big Mac. Begin by asking the students, "Where did the meat come from?" Continue questioning until they reach the source of the ingredients: sun, earth, air, and water. Give guidance where needed. Your chart may be a simpler version of this.

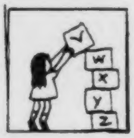

AIR
SOIL
WATER
GRAIN
COW
MEAT
HAY
COW
MILK
AIR
SOIL
WATER
BUN
WHEAT
AIR
SOIL
WATER
TOMATO
AIR
SOIL
WATER

140

MORE

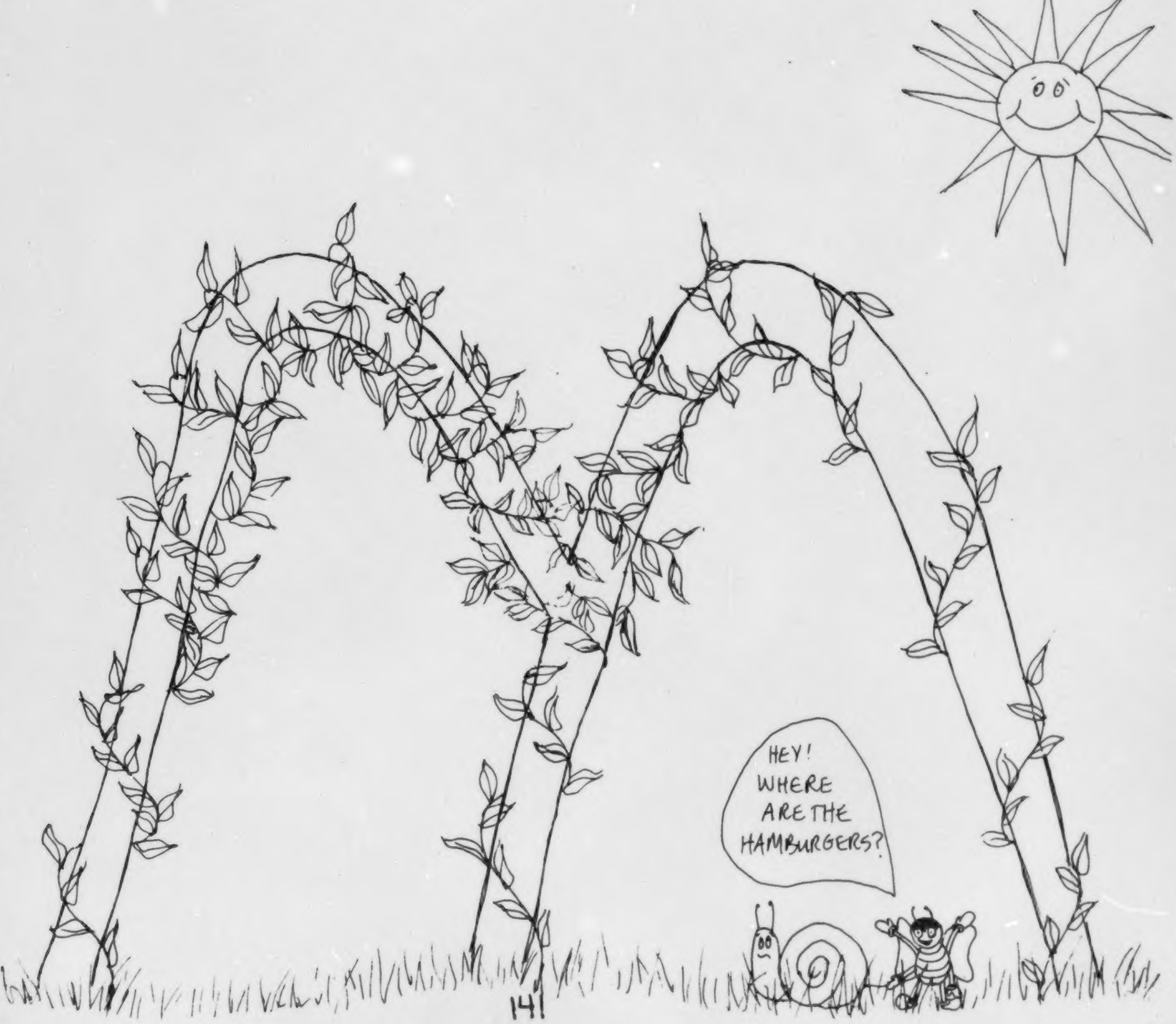
How long could you live without any one of the "Big Four"? Can you identify a living thing that could survive without the "Big Four"?

*Ask the students to plan a meal that does not in some way depend on the Big Four. Is this difficult?



*Have each class member use his or her favorite meal and make a food flow chart tracing the food back to its beginning. Where does all the food ultimately come from?

*Try the same thing tracing the packaging required at each step. Where does all of the packaging go? Where does it all ultimately come from?



HEY! WHERE ARE THE HAMBURGERS?

141

Seedy Character

purpose

To provide the opportunity to look closely at different kinds of seeds.

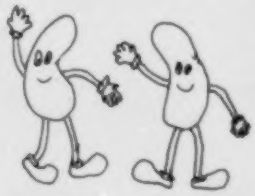
Materials: Paper, pencil, and a tray with a variety of seeds (such as coconut, avocado, apple, nuts, beans, pumpkins, and potato eyes). Set lima beans soaking in water (one for each member of the class) one day prior to the lesson.

ACTION

Read the following to the students as an introduction to the lesson:

Some seeds are very nutritious for us to eat. They are very rich in protein, minerals, fats, and vitamins. Why are they so nutritious for us? Life comes from seeds. A whole plant grows from a seed. Did you ever consider that a small apple seed in the core of the last apple you ate could become a large tree with fruit?

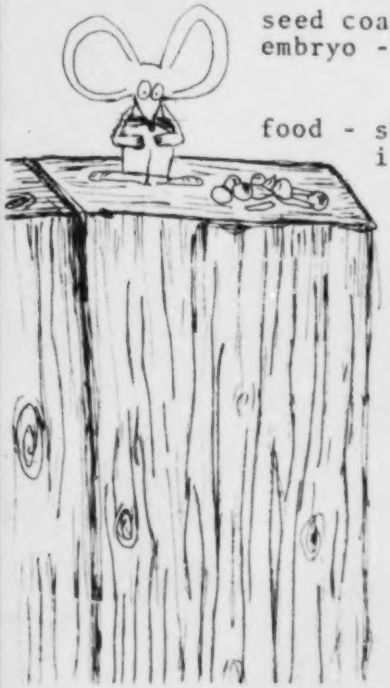
*Have students examine the seeds on the seed tray and list each kind with a description. Have them make as many observations regarding the seeds as they can.

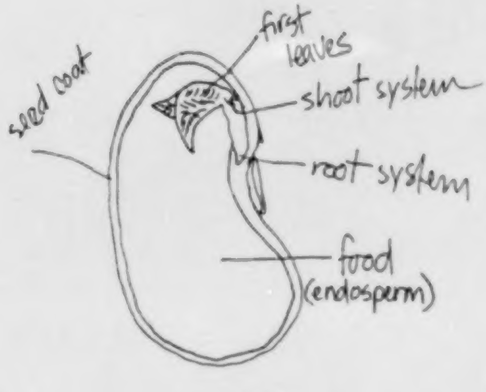


*Now ask students to divide the seeds according to categories (such as big vs. little, soft vs. rough, edible vs. non-edible, dark vs. light, etc.) How many categories can they come up with?

*Take the soaking lima beans and cut in half lengthwise. Identify the following parts:

seed coat - outer protection of seed (usually paper-thin).
embryo - part that will grow into plant. See if you can identify the root system and shoot system that will grow from embryo.
food - surrounds embryo. Embryo uses food to grow until it is big enough to produce its own food.





MORE

142

What is the function of the seed coat? The food? The root system? The shoot system? Can a seed sprout without soil? Why?

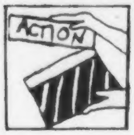
Have students go into the garden and collect seed from different plants. The seed is ready when the seed pod is brown and dry. Describe and categorize your "home-grown" seeds.

Adapt-a-Seed

purpose

To discover some plant adaptations for survival.

Materials: Seeds (such as bean, pumpkin, corn, pea), construction paper, tape, paste, rubber bands, toothpicks, balloons, scissors, pencils, plastic bags, cork, cotton, feathers, tacks, metal springs, wire, any other useful looking materials.

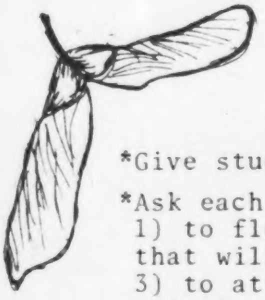


Read the following to students as an introduction:

Open up any fruit and inside will be seeds. Fruit and seeds go together. When a flower makes seeds, it also makes fruit. The fruit holds and protects the young seeds until they are ready to become new plants.

Many plants have mechanisms or ways to disperse their seeds away from the established parent plants. This dispersal increases the likelihood that some seeds will arrive in a better place more favorable to growth.

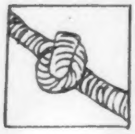
Have you ever seen flying and whirling maple seeds? Some seeds float, some "fly," some burst from their parent plant like a bullet. Other seeds have hooks on them so they can catch a ride on an animal. Although all seeds are different, they all have one purpose: to become a new plant.



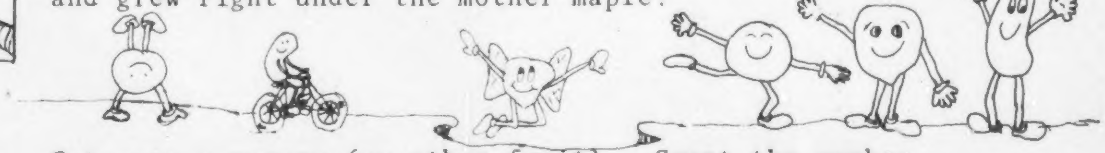
*Give students seeds to be adapted.

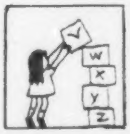
*Ask each student to adapt their seed in one of the following ways: 1) to float on water at least five minutes; 2) with a mechanism that will throw the seed two feet away from the parent plant; 3) to attract a bird or other animal; 4) to hitch-hike on an animal or person for 20 feet; and 5) to fly at least three feet.

*At completion, share and demonstrate dispersal inventions.



Why do seeds have dispersal mechanisms? Predict what might happen if maple seeds fell straight to the ground and grew right under the mother maple?





Cut open a pepper (or other fruit). Count the number of seeds inside. How many seeds does it take to make one pepper plant? How many pepper plants could you grow from the seeds in that one pepper? If one pepper produces 30 peppers, how many plants could you grow from all the seeds of those 30 peppers? Why don't peppers cover the earth?

Adapted from Outdoor Biology Instructional Strategies, University of California

Samson and Delilah

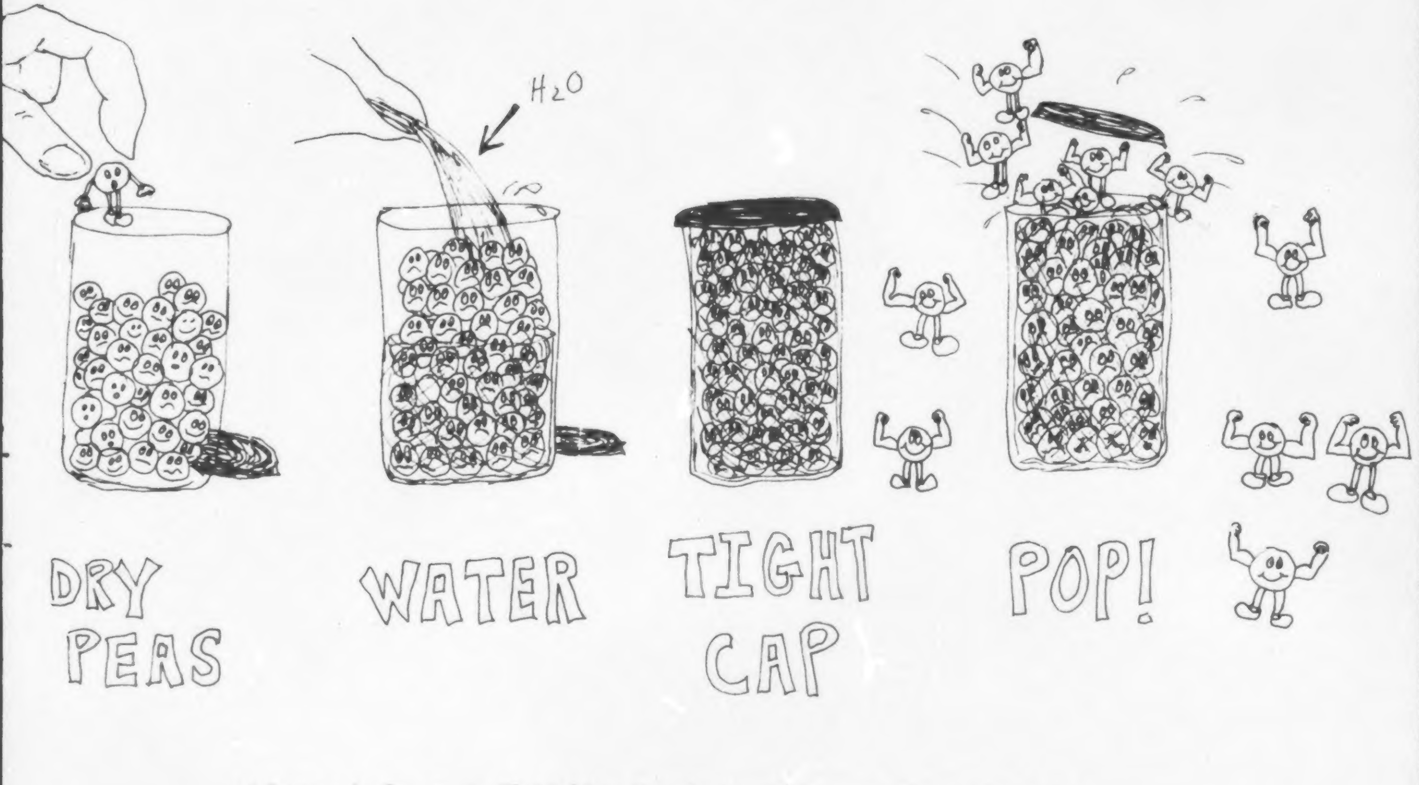
purpose

To demonstrate the response of seeds when mixed with water.

Materials: small bottle with cork stopper, pea seeds

Germinating seeds are strong. We can observe their strength with this experiment.

Fill a small bottle or plastic vial with seed (peas or beans). Fill the bottle with water. Stopper the bottle with a cork or piece of plastic held tight by a rubber band. Ask your students to predict what will happen to the jar. Wait about six to eight hours for the swelling seeds to pop off the cork or lift up the plastic cover. Water moves into the seed cells through the seed walls. This swells the seed and puts pressure on the container. This principle was used to stretch a tight pair of leather shoes years ago.



Adapted from A Child's Garden, Chevron Chemical Company

It's Getting Stuffy In Here

purpose

To demonstrate how the amount of air available to a seed affects germination.

Materials: GLASS JAR, SOIL, BEANS OR PEA SEEDS

Most seeds will sprout in the dark. All they need is moisture, the right temperature, and air.

The amount of air in the soil depends upon the structure of the soil and the amount of water in the soil. When the water moves through the soil it drives air out by filling the air spaces between soil particles. As water drains through, air carrying oxygen moves from the soil surface into the soil.

Does the amount of air in the soil vary according to the depth of the soil? Does the amount of air affect seed germination? To find out, do this:

*Fill a large glass with about one inch of soil.

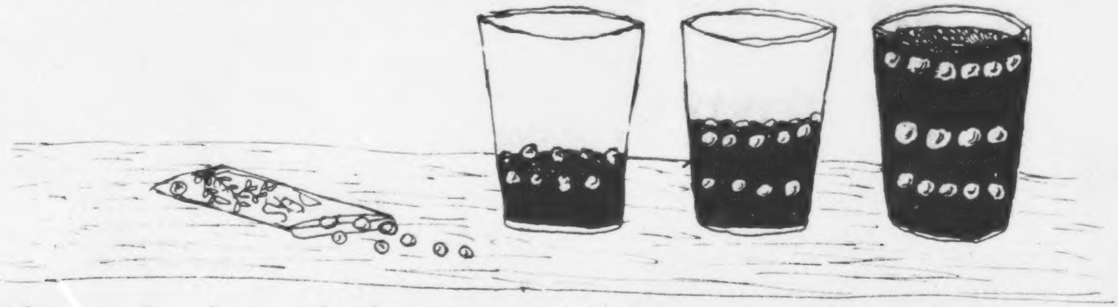
*Firm the soil down and then put a few seeds next to the glass on the inside. Use large seeds such as garden beans or peas to work with.

*Then put one more inch of soil in the glass and firm it down.

*Plant a few more seeds next to the glass.

*Repeat with one more inch of soil and more seeds.

*Then moisten the soil with water but don't add too much. Pour off any extra water. Place the glass in a dark place. A warm location would be best.



After a few days, check to see which layer of seeds sprouted best. Be sure that you keep the soil moist during your experiment but not too wet. If you keep the soil in the glass too wet, the seeds may not germinate at all. Seeds usually germinate poorly and most plants grow poorly in wet soils. This is due mainly to the lack of air in the soil.

Luna-Seeds

purpose

To discover the effect of the cycles of the moon on seed germination.

Materials: seeds, soil mix, journals

*Read the following to your students: If you look up at the sky every night for a month, you'll see the shape of the moon change. This change is caused by the monthly revolution of the moon around the earth. The light from the moon is really just a reflection from the sun, and that reflection changes as the moon moves around the earth. The moon affects many things on earth, including many peoples' moods! One of the most important natural effects of the moon is on the tides and on the flow of water on our planet. Did you know that the tide is highest (and lowest!) when the moon is full? Just as the full moon causes the tides to swell, it causes water in the ground to move. That's where seeds come in. Water is needed to swell the seed until the seed coat finally breaks, allowing the seedling to emerge. Supposedly, seeds sown just before the full moon germinate quicker then at any other time, because the full moon has great influence on the flow of water on earth.

Let's find out if the phase of the moon really makes a difference in the germination of seedlings!

*Pick a variety of seeds, like radish (a fast germinator) and carrot (a slow germinator).

*Two or three days before a full moon, sow a flat of the different types of seeds, making sure to label each type. Keep well watered.

*Observe daily and record in your journals the exact date of germination of each kind of seed.

*Repeat the experiment on the day of the new moon.

How did the phase of the moon affect germination? When was it faster? When you sowed near the full moon? Was there really any difference?

*Try the entire experiment outdoors, sowing the seeds in the ground this time. Does this change the results of the experiment? If so, why?

147

Lotus Seeds

How Long Will a Seed Last?

Once there was a beautiful lake in China. In the waters of this lake grew the sacred and respected lotus plant. Each year, seeds from the lotus fell into the clear water and slowly sank to the bottom of the lake. Over many years, the lake dried up. The seeds that had fallen from the flowers of the lotus stayed buried in the muddy bottom of the dried-up lake. The seeds were very hard, covered with a tough outer skin.

Many years passed. The land that had once been a lake was used for farming. A scientist came and began to dig in the farmland, for he was interested in its history. He found the lotus seeds. As an experiment he decided to try to sprout them, so he took them to his laboratory in Washington, D.C. He put them in strong acid to dissolve the hard seed coats and then planted them. He saved a few seeds to be tested with a new method called radiocarbon dating, which would tell him exactly how old the seeds were.

While the seeds were in the soil, he found out that they were over one thousand years old! After learning that news, he doubted that they would ever germinate. Then one morning in June 1952, a tiny sprout poked through the soil. The thousand year old seeds had sprouted!! Today they are still growing in the Kenilworth Aquatic Gardens of Washington D.C.

Of course, not all seeds last that long. The hard coats and the fact that the seeds were buried so deeply helped these lotus seeds to survive.

Adapted from Ladybugs and Lettuce Leaves, Project Outside/Inside, Sommerville Public Schools

Growing Growing GONE

purpose

To demonstrate that seeds have different stages of development.

Materials: LIMA BEANS, JAR, ALCOHOL, PAPER TOWELS

This experiment has students observe how a seed becomes a plant.

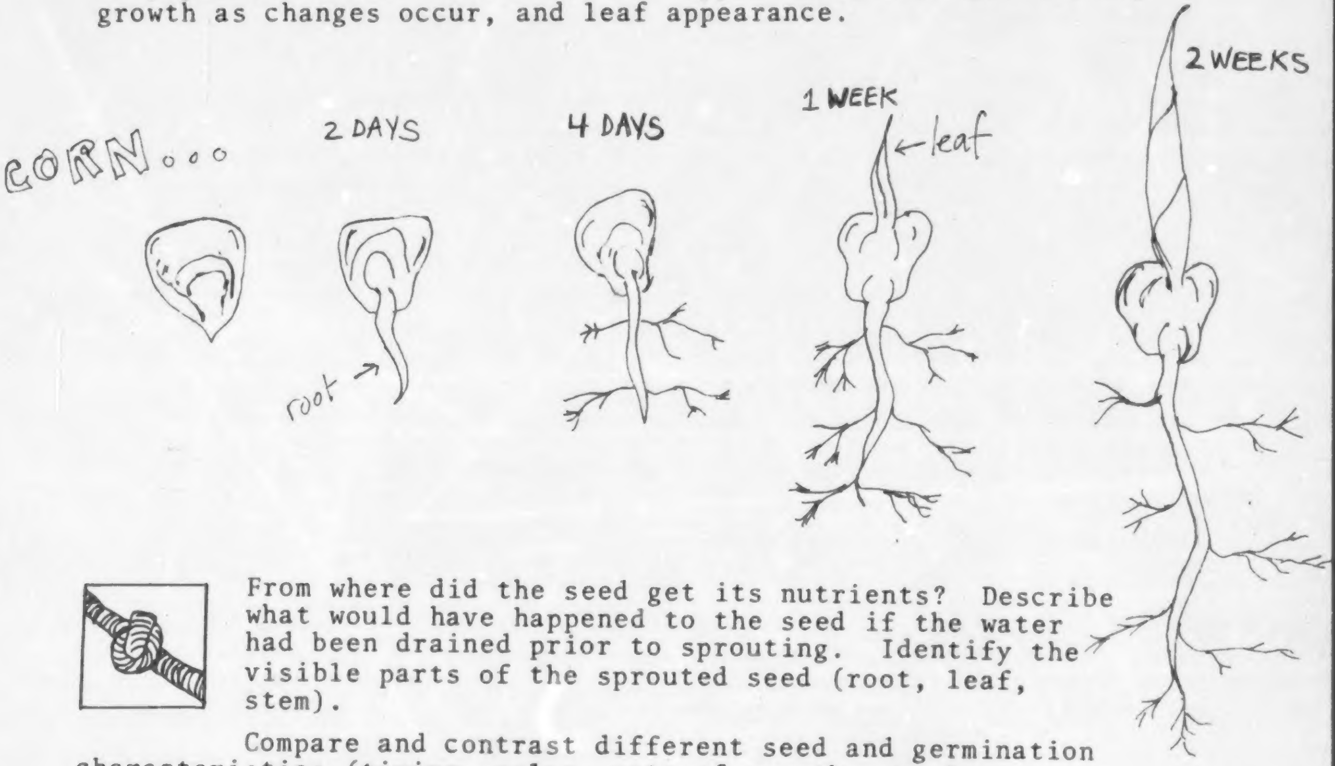
*Put the beans in a jar of water and soak 24 hours.

*Pour off the water and replace it with wet towels.

*Keep the seeds against the side of the jar and approximately two inches from the bottom.

*Take one seed out every other day; drop the seed in rubbing alcohol to stop its growth -- and label.

*After five days in alcohol remove the seed, dry it and mount it on paper and label. Describe seed appearance, root growth, top growth as changes occur, and leaf appearance.



From where did the seed get its nutrients? Describe what would have happened to the seed if the water had been drained prior to sprouting. Identify the visible parts of the sprouted seed (root, leaf, stem).

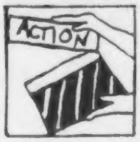
Compare and contrast different seed and germination characteristics (timing, color, rate of growth, etc.).

Glass Seed Sandwich

purpose

To allow students to observe that plant roots grow toward water.

Materials: TWO PIECES OF GLASS, PAPER TOWEL, RADISH SEEDS



Prepare the glass seed sandwich by doing the following:

*Soak a folded piece of paper towel in water.

*Fold another dry piece the same size as the wet piece.

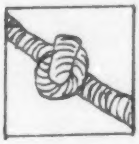
*Place the towels on one of the pieces of glass, separating the two pieces by ½ inch.

*Place radish seeds in the space between the two pieces of toweling, being careful to keep the seeds dry.

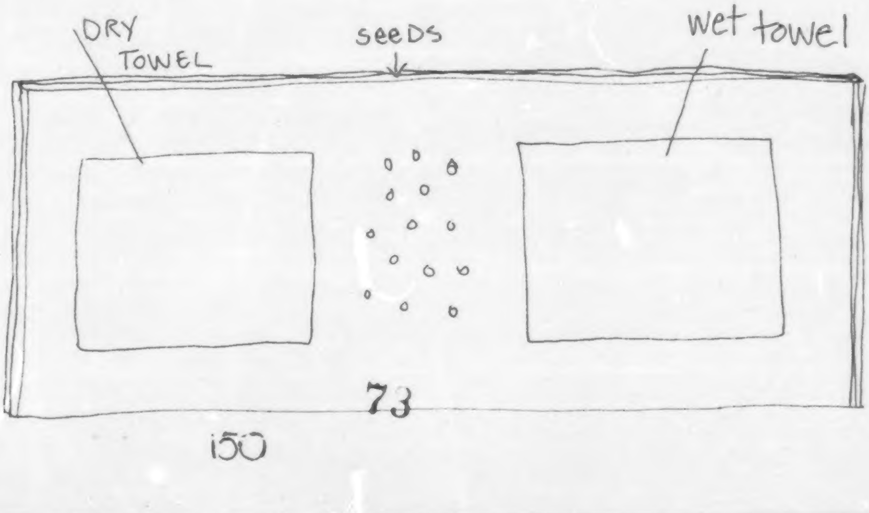
*Place the other sheet of glass over this and tape the sides together.

It helps to soak the radish seeds for a day prior to use.

After the seeds sprout, use the Glass Seed Sandwich to illustrate hydrotropism. This is the inherent capacity of a green plant's roots to grow toward water sources. This built-in sensor is what helps plants survive in times of drought. When we humans become thirsty, we move our body to a source of water. Plants can't do that. When a plant needs water, its roots grow toward water so that it can bring back to the plant needed water. Recent studies have shown that a single corn plant can produce over 80 miles of roots; a tomato plant up to 50 miles, in search of water.



Which direction did the roots grow? Toward the dry or wet paper toweling? Why? What would a plant do without water? (Die) Why does a plant need water? What does water bring the plant? (Nutrients and air) How much of the human body is water? (Over 70%) What percentage of most plants is water? (Over 80%)



Let's Get To The Root of This (Geotropism)

purpose

To illustrate root growth and function.

Materials: Vegetable seeds, soil, root view box*(see construction details on next page).

Prepare by planting a variety of vegetable seeds with your students one month prior to use.

To see how roots work and how different kinds develop, we are going to use a root viewing box. Since we cannot see through the soil in our garden, we will use this box to see the underground action of roots. We have planted different types of seeds in the box to see different types of roots.

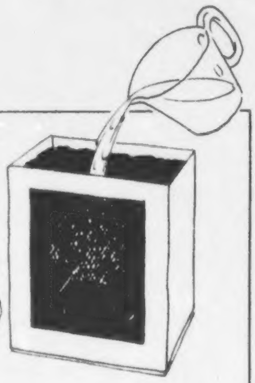
Look very closely at the roots. Do you notice any very thin, hair-like threads on the large roots? These are called root hairs; a grown plant can have miles of them. In fact, a certain type of grass was measured to have 6,600 miles of root hairs coming from one plant. Root hairs are the real wonder workers of the system. They absorb all the water and minerals for the plant. The water that most plants take in through their root hairs is not from puddles and streams. It comes from a thin coating of water that is around each grain of soil. The root hairs absorb this water into the plant. Each tiny drop of water that is absorbed has the mineral nutrients from the soil in it. As the root hairs grow, they find new supplies of water and nutrients. This supply of water and soil nutrients is moved upwards from the root hairs. First it goes through pipelines inside the larger roots, then into the stem, and finally into the leaves. What do you think happens there?

Geotropism is the inherent capacity of plants to direct their roots downward toward the pull of gravity. Plants germinated in complete darkness, lacking any environmental cues (light, wind, etc.) will send their roots downward.

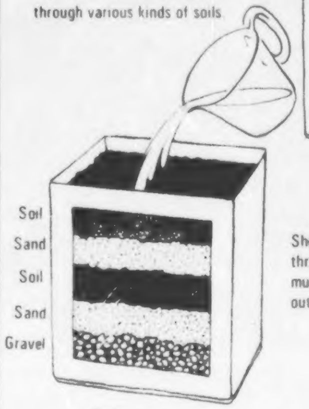
What would happen to the roots if we turned this box on its side for a couple days? Why? Which of these roots are edible? Why do different plants have different root systems? What do roots do for the plant? How might these roots appear if they were growing in sand? clay? Could we grow plants in other substances like cotton or styrofoam? Why? What do non-soil substances lack? What would happen if a plant grew its roots into the air or sideways along the top of the soil? How would the roots look on a plant without gravity? Are roots strong? Have you ever seen roots growing through cement? Can you name any places where you have seen roots growing through a strong material?

MAKING AND USING ROOT VIEW BOXES

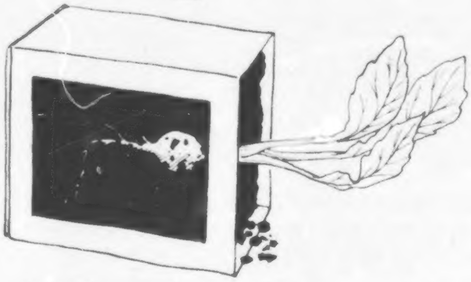
Some root view box experiments



Show the movement of water through various kinds of soils.



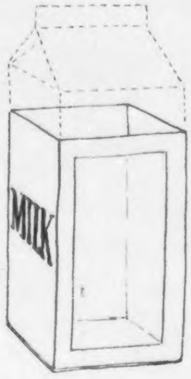
Show how water moves through soil layers. How it must build up a head to move out of one into another.

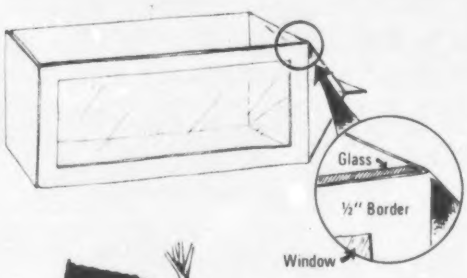


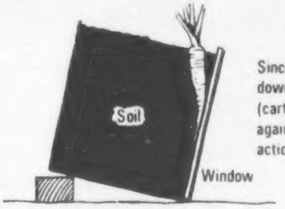
See how the roots and the top of a plant change their growth when the box is laid on its side after the plant has developed in the upright position.

Milk carton root view boxes

Cut the top (for a vertical box) or the side (for a horizontal box) from a half-gallon milk carton. Cut out window area leaving about ½ inch of carton between corner and window. Cut glass to fit tightly into the corners of the carton. Waterproof glue or pruning paint may be used for a tighter seal.

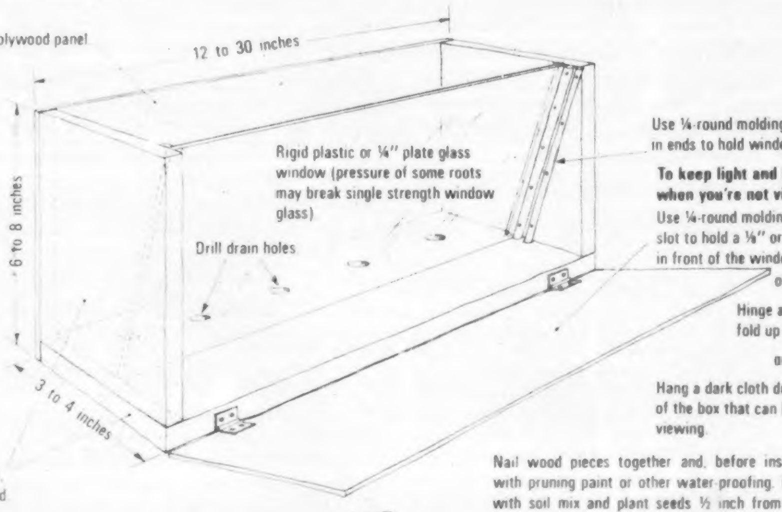






Since roots tend to grow straight down, the window must be slanted (carton tipped) to keep roots growing against the glass and all of their action visible.

How to build a root view box



Back: ½" exterior plywood panel

Rigid plastic or ¼" plate glass window (pressure of some roots may break single strength window glass)

Drill drain holes

Use ¼-round molding or cut slots in ends to hold window.

To keep light and heat off the roots when you're not viewing them:

Use ¼-round molding or cut another slot to hold a ⅛" or ¼" wood panel in front of the window . . .

or

Hinge a panel to the front that will fold up and cover the window . . .

or

Hang a dark cloth drape from the top of the box that can be lifted for viewing.

1" cedar, redwood, or exterior plywood

Nail wood pieces together and, before inserting window, spray interior with pruning paint or other water-proofing. Fill to within 1 inch of the top with soil mix and plant seeds ½ inch from window. Keep soil moist but not soggy.

152

REPRINTED FROM A CHILD'S GARDEN CHEVRON CHEMICAL COMPANY

Run Root Run

purpose

To observe that roots can grow around barriers in the soil.

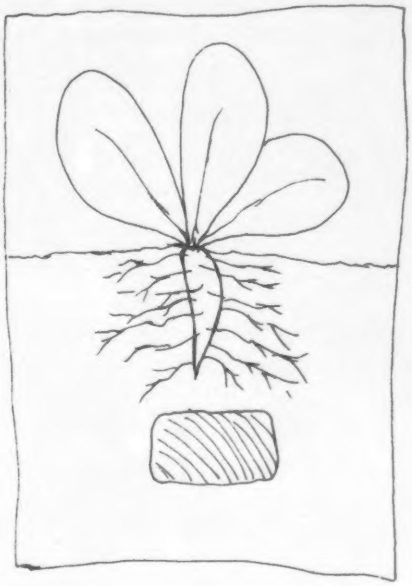
Materials: ◦ Seedling (such as marigold, pea, bean, etc.), small ◦ flat or box with soil, small piece of wood 4" x 1".

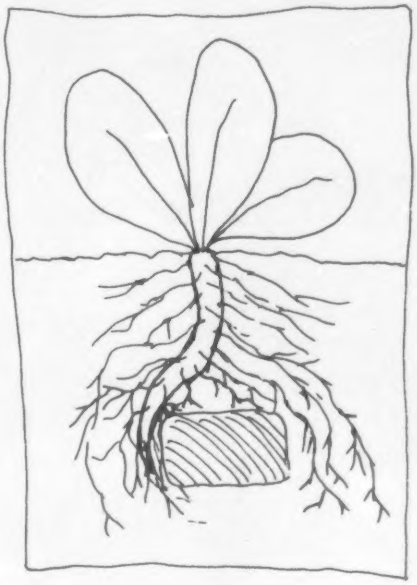
ACTION

*Plant a seedling such as a young marigold in a flowerpot about ½" above the piece of wood. Place the wood firmly so it will make a barrier as the roots go down.

*After one week brush aside enough soil so you can see the roots beginning to find their way around the wood. Replace the soil, pressing it gently, and rewater.

*Check in a few more days to see if the roots have turned completely.





ADAPTED FROM A CHILD'S GARDEN, CHEVRON CHEMICAL CO., ORTHO DIVISION, SAN FRANCISCO 1978

Let's Get A Handle On This Or...

Get Your Tendrils Off Me!

(Thigmotropism)

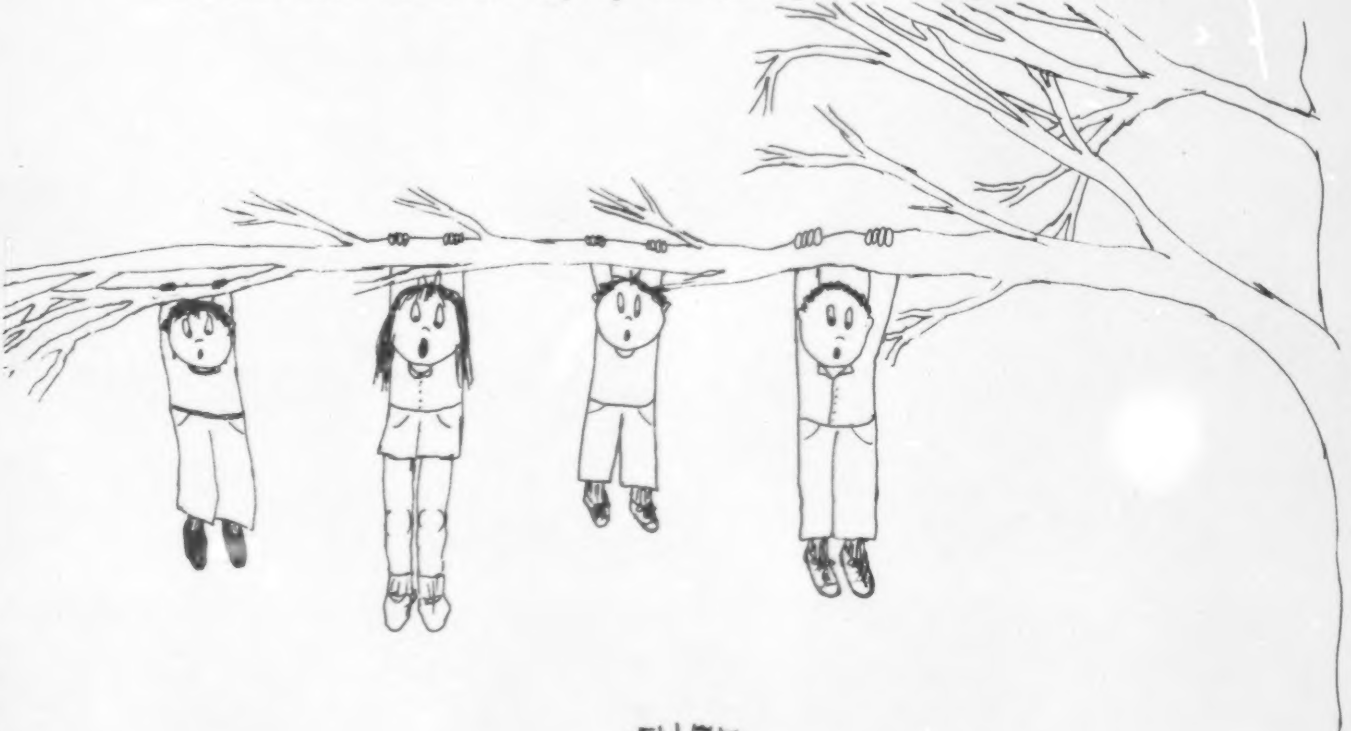
purpose

To demonstrate the drive of certain plants to connect to outside structures for support.

Materials: Small pot, climbing pea seeds, small sticks.

ACTION

Thigmotropism is the inherent response of certain plants to grab onto things. For this experiment, first plant the seeds in the pot. When they first sprout insert a twelve inch stick in the soil next to the sprout. After the second set of leaves appear watch the plant closely. Very soon after this the plant will send out tendrils which will latch onto the stick. When the plant reaches the top of the stick, put a larger stick on the other side of the plant. The plant will then reach towards that stick and grow around it. For the next step tie a string to the top of the second stick and the other end to a curtain rod or nail above a window. The vine will wind its way up the string. Record growth rate.



Which Way Did It Grow?

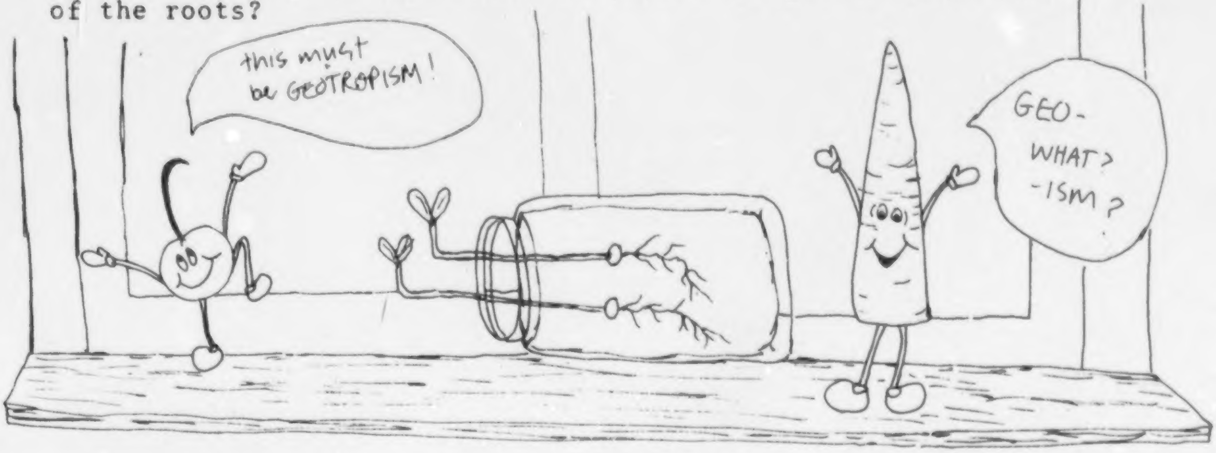
purpose

To demonstrate the effect of gravity on plants (geotropism)

Materials: glass jar, wet paper, radish seeds

Geotropism describes the plants response to gravity; that's why roots grow down and stems grow up.

Soak your radish seeds and place them in a glass jar that is lined with wet paper. Grow the seeds in the dark until the stems are about one inch long. Pour off the excess water from the jar and turn it on its side. Keep it in the dark. Wait 24 hours and notice the growth of the stem. Now turn it in the dark for 24 hours. What happened to the stem now? What does this experiment tell you about the growth of the stem? How about the growth direction of the roots?


this must be GEOTROPISM!
GEO- WHAT? -ISM?

Experiment with phototropism, the response of plants to light. Cut out one inch square at one end of a shoe box. Fill with gravel and top with soil until two-thirds full. Plant bean seeds. Water to moisten, and cover the box with the lid. Do not peek except to water. In a week, watch how the new plant will be bending toward the patch of light at the opened end.

Plants sweat?
Yes It's true

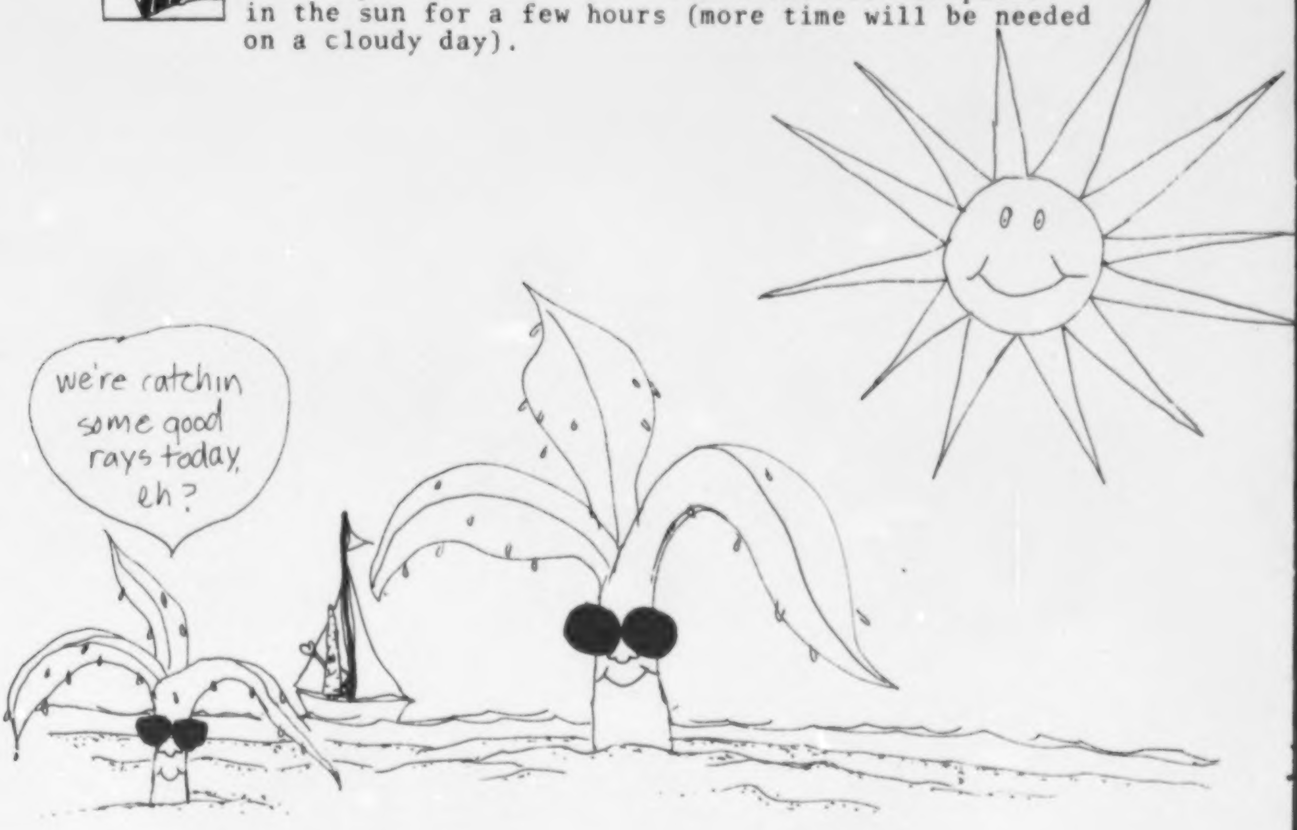
Plant Sweat

purpose

To demonstrate the manner in which excess water leaves a plant.

Materials: small potted plant, clear plastic bag, tie

First thing in the morning on the day of this lesson, or the afternoon before, water the plant well. Then cover the plant with a plastic bag tied at the point where the stem meets the soil. Be sure to have the soil exposed to the air. Place the covered plant in the sun for a few hours (more time will be needed on a cloudy day).


we're catchin some good rays today, eh?

Later: Ask the class what they see on the inside of the bag? Where did it come from? Transpiration is the plant's way of sweating; releasing excess water into the air through its leaves. The constant flow of water through the plant gives it shape and life. Plants are solar powered. Water enters through the roots carrying air and nutrients. It is pulled through the plant continuously in columns by evaporation caused by the heat of the sun.

156

Room to Live

purpose

To discover the effects of crowding on the growth of plants.

Materials: several pots, potting soil, radish seeds

How much room do you need to live? If you grew up in a room three feet high by three feet wide, do you think it would be easy to grow up to be a basketball player? Plants need room to grow, just like people. Their roots need room to spread out and soak up nutrients and their leaves need room to spread out and soak up the sun. Let's see how crowding affects their growth.

*Fill small pots with soil, and number them with labels. Then sow radish seeds, equally-spaced, in each pot:

Pot 1: 2 seeds
Pot 2: 4 seeds
Pot 3: 8 seeds
Pot 4: 16 seeds
Pot 5: 32 seeds

and so forth until you have a very crowded pot.

*Place pots in a sunny place and keep them watered as the seeds grow. Observe them carefully to see if the radishes in some pots are growing better than others. Note if some are tall and spindly, others stunted, etc. Write down your observations about each pot every few days.

*When the radishes are full-grown, carefully pull them out of the pots, making sure to keep each pot separate. Measure the length of each radish leaf and root, then take an average root and leaf length for each pot.

*Gather all your information, and decide which pot produced the biggest, healthiest radishes. Did crowding seem to affect their growth?

Seed to Earth, Seed to Earth...
Do You Read Me?

purpose

To demonstrate the effects of different soils on plant growth.

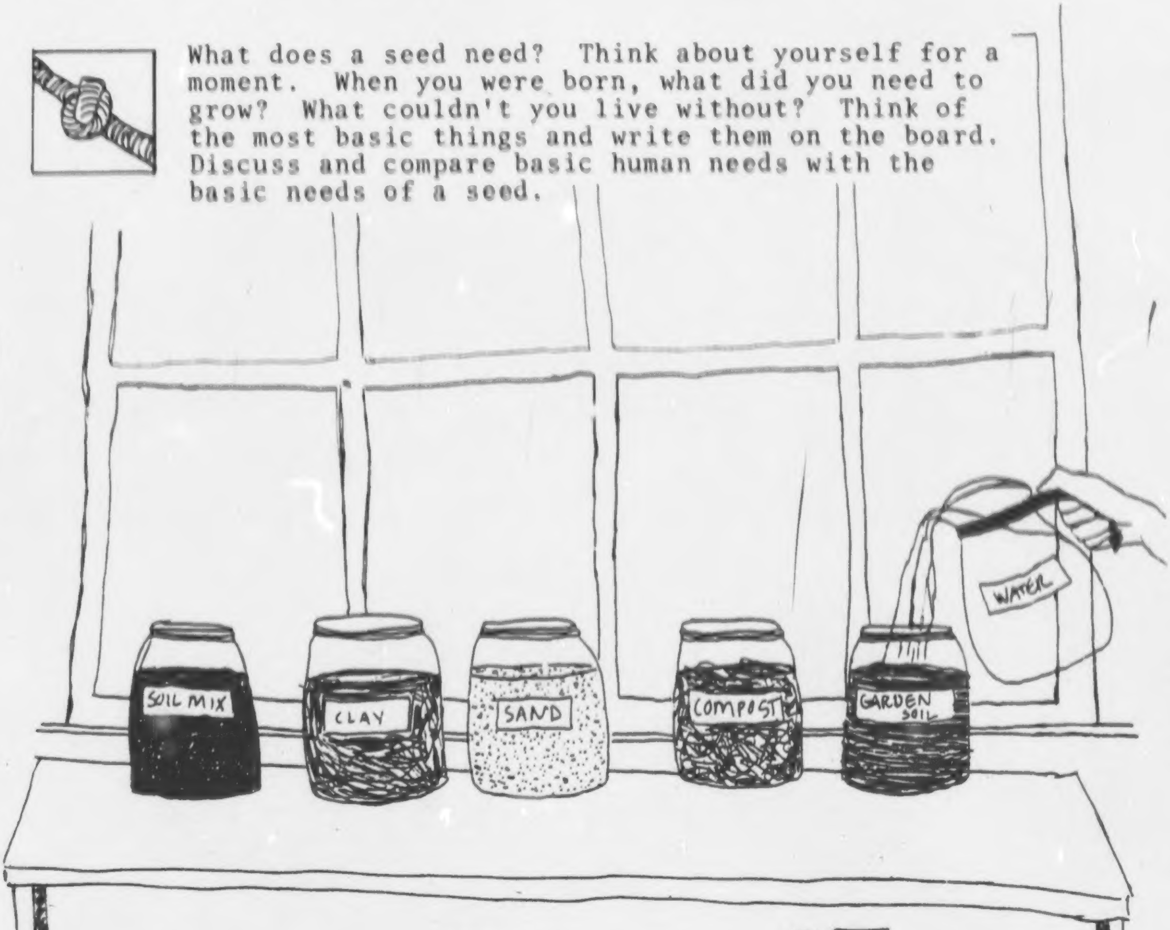
Materials: 5 pots, seeds, different soils

By observing the health of seed growth in different soils, we can learn more about plant needs.

*Fill containers with different kinds of soil (ie., sand, clay, compost, mulch, pine needles, garden soil, soil mix). Pour equal amounts of water into each container. Observe and compare the soils' water-holding ability.

*Plant seeds in each container. Observe differences in germination and growth. Keep a record in journals. Continue for at least three weeks.

What does a seed need? Think about yourself for a moment. When you were born, what did you need to grow? What couldn't you live without? Think of the most basic things and write them on the board. Discuss and compare basic human needs with the basic needs of a seed.



MORE

Plant seeds under various conditions without soil.
Label four petri dishes:
Dish A - Water & Light
Dish B - Water & No Light
Dish C - Light & No Water
Dish D - Water & Cold

Put paper toweling and two seeds in the bottom of each dish.
Dish A - Moisten the paper with water and place the dish in a sunny window. Do not allow the paper to dry out.
Dish B - Moisten the paper with water, place it in a dark closet or in a bag. Do not allow the paper to dry out.
Dish C - Do not add any water. Place the dish in a sunny window.
Dish D - Moisten the paper with water, place the dish in a refrigerator.

Observe changes in the seeds for ten days. Make a chart and record your observations.

FROST FREE
PRODUCE
MEAT
FRUIT

The Big Sleep

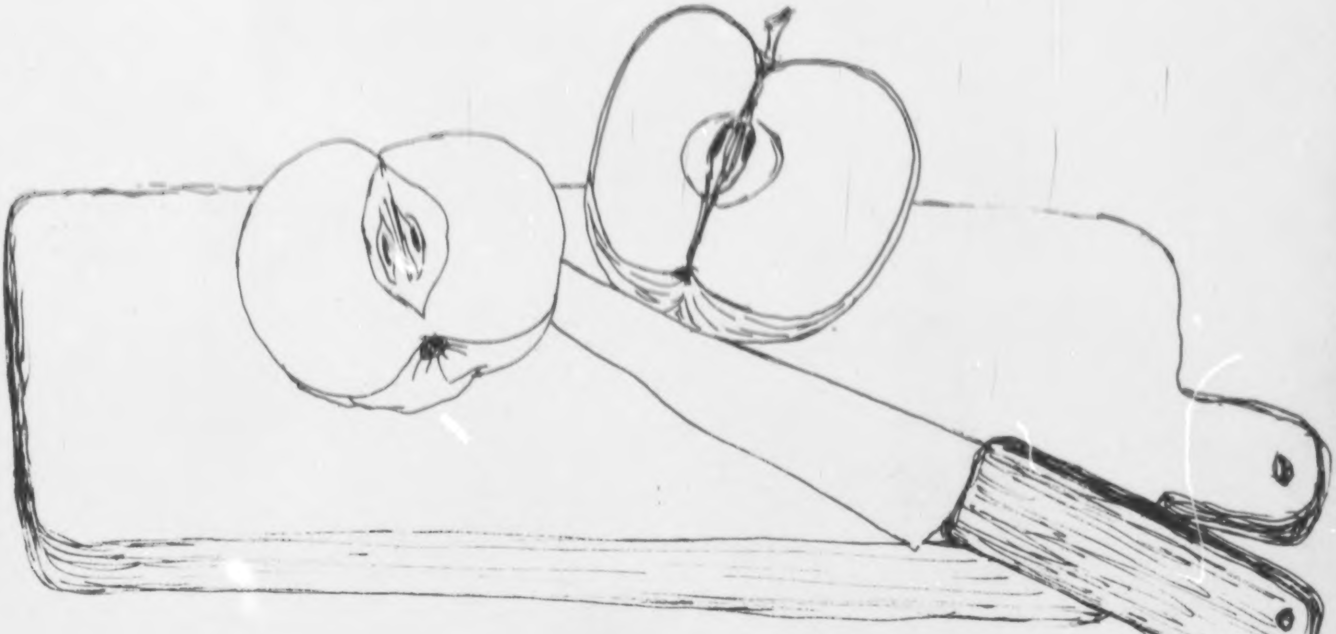
purpose

To demonstrate the need of deciduous seeds for a period of moist winter chilling.

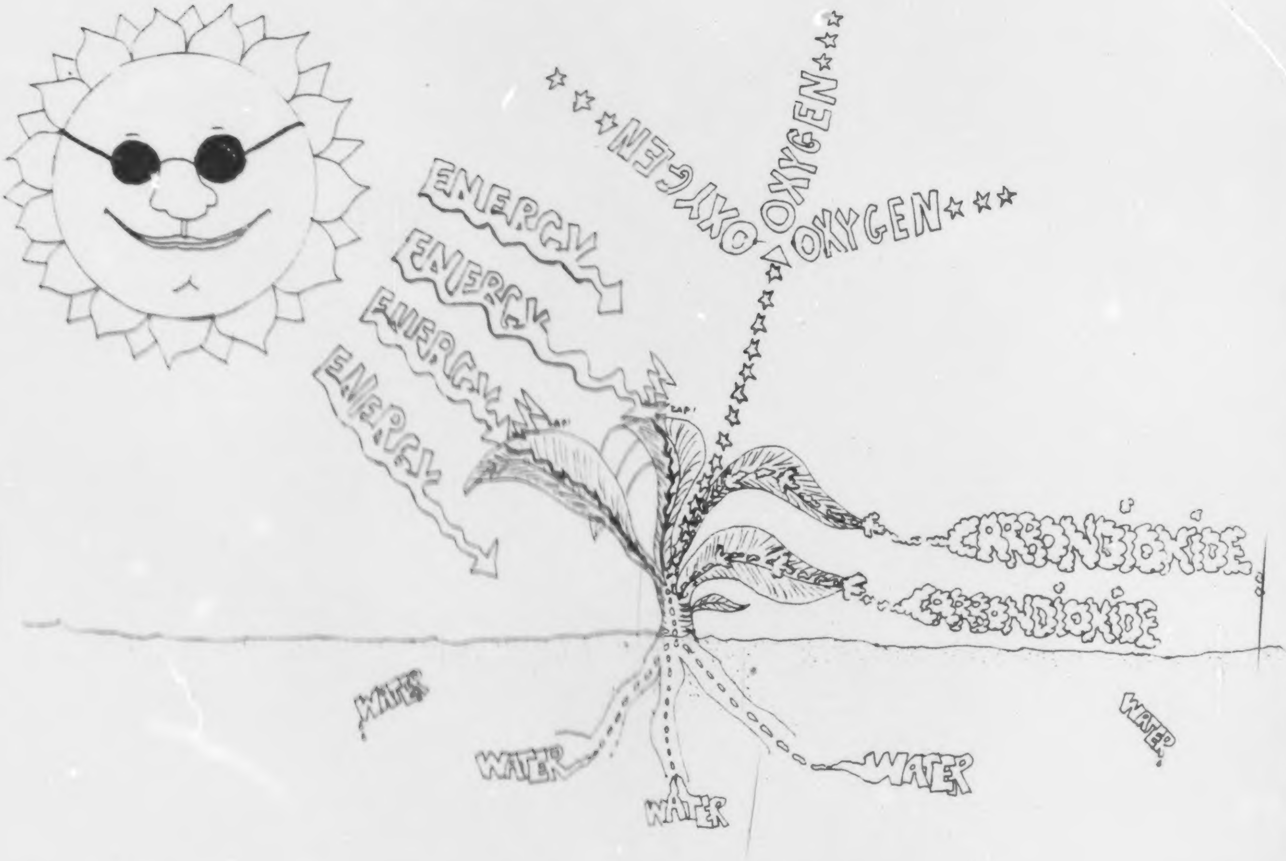
Materials: apples, vermiculite

Many of the fruits you eat have seeds that you can raise into seedlings. Before sprouting, seeds of deciduous fruits need a period of moist winter chilling. This breaks their natural dormancy. You can supply the chill by storing your seeds in the refrigerator at 40°F. Provide moisture by placing them in plastic bags with wet vermiculite for 2 to 3 months. You can also put apple seeds on moist paper in a jar, covered with moist paper and put into the refrigerator. If you keep the paper moist, the seeds will sprout in 6 to 8 weeks.

Fruits you grow from store-bought produce are plants mainly to experiment with. They can't be counted on to grow into productive trees. Orchard trees are not grown from seeds, but from carefully selected grafts and buds on seedling root stocks. At any rate, enjoy the "fruits" of your labor!



PHOTOSYNTHESIS


OXYGEN
OXYGEN
OXYGEN
OXYGEN
ENERGY
ENERGY
ENERGY
ENERGY
CARBON DIOXIDE
CARBON DIOXIDE
WATER
WATER
WATER
WATER
WATER

We are all solar powered; fueled by the green plants special capacity to convert the sun's energy to food. All human energy stems from this process called photosynthesis. This unit introduces photosynthesis with emphasis on the oxygen-carbon dioxide cycle.

Lesson Titles	Recommended Grade Levels
Sugar Factories	4-6
Let's Make A Deal	4-6
Magical Mystery Tour	4-6
You Light Up My Life	5-6
Plants Need Light Too	4-6

Special Materials & Where To Find

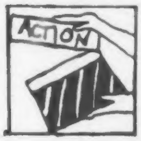
Elodea (an aquarium plant) - Pet shops that sell fish

Bromothymol Blue - Chemical Supply House, or
Wards Scientific Supply
Box 1749
Monterey, CA 93940
or use boiled red cabbage juice

Sugar Factories
ALL DONE!

purpose

To introduce the concept of photosynthesis.



Read the following to your students:

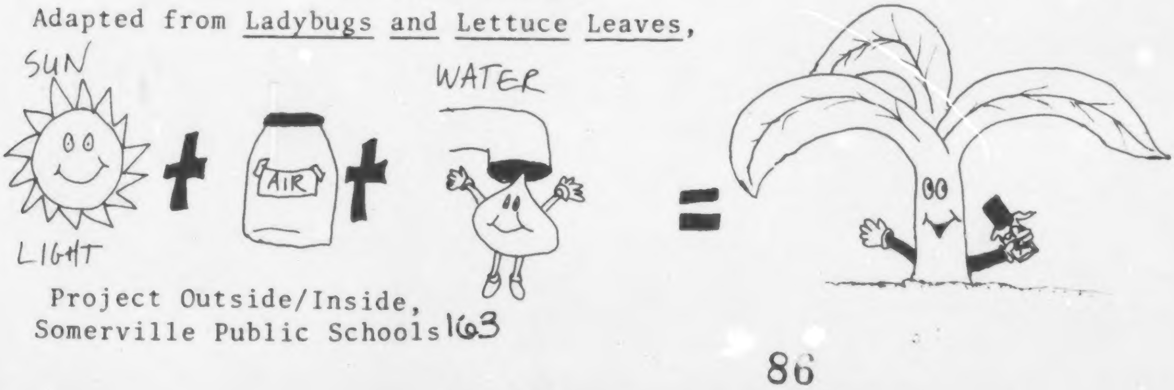
THE TREE EXPERIMENT

About 350 years ago, a man named Jan Van Helmont decided to find out how plants grow. At that time, most people thought plants ate soil. Jan wasn't sure this was true, so he set up an experiment to find out for himself. He planted a small, 5-pound willow tree in a pot of dry soil weighing 200 pounds. Jan figured that if the tree ate the soil, then the weight of the soil should get less and less.

For five years Jan watered and took care of the willow. It grew very well and became a handsome 169 pound tree. Then Jan weighed the soil again. He was careful to let the soil dry out so that it would be as dry as when he first planted the tree. The soil tipped the scales at 199 pounds and 14 ounces, only 2 ounces lighter than the original 200 pounds! Where did the tree get the food to grow 164 pounds? Jan thought it all came from the water he added. Where do you think it came from? What question did Van Helmont set out to answer? What were his conclusions. Was he right?

Since Van Helmont's time we have learned that plants make their own food from the sun's energy--This is called Photosynthesis. Life, as we know it depends on this unique ability of green plants to convert the sun's energy into food. Photosynthesis is one of the most important chemical reactions on earth. We are totally dependent on plants for our food. No other living organism can make the sun's energy available to us as chemical energy. Photosynthesis takes place within the chloroplasts of plant cells. There the raw materials, water and carbon dioxide, are combined chemically in the presence of sunlight and chlorophyll. Some of the resulting sugar is immediately transported to other parts of the plant. Some of the sugar is changed to starch and stored temporarily in leaves. Oxygen is released into the air as a by-product of this process. We could neither breath nor eat without green plants. Next time you pass one by, stop and say thanks. It's the least you can do.

Adapted from Ladybugs and Lettuce Leaves,



Project Outside/Inside,
Somerville Public Schools 163

Let's Make a Deal

purpose

To understand that green plants release oxygen and consume carbon dioxide, while animals release carbon dioxide and consume oxygen.

Materials: Old bicycle positioned with the rear wheel free to rotate (as in an exercycle), plastic tube with cup attached to bike and connected to tree leaves.

Plants and animals are involved in a great exchange every day. This exchange involves a trading of oxygen released from the plants by photosynthesis, and carbon dioxide released from the animals during respiration. In this way the earth's limited air supplies are recycled.

*Ask the group, "Who would like to play 'Let's Make a Deal'?" Lead the group to the stationary bicycle connected to the tree. Point out the special breathing tube and cup which connects the rider to the tree leaves.

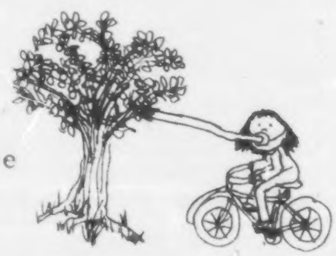
*Have one student begin to pedal the bike explaining that s/he must breathe into the tube connected to the tree. The student is breathing out carbon dioxide to the tree and receiving oxygen back from the leaves.

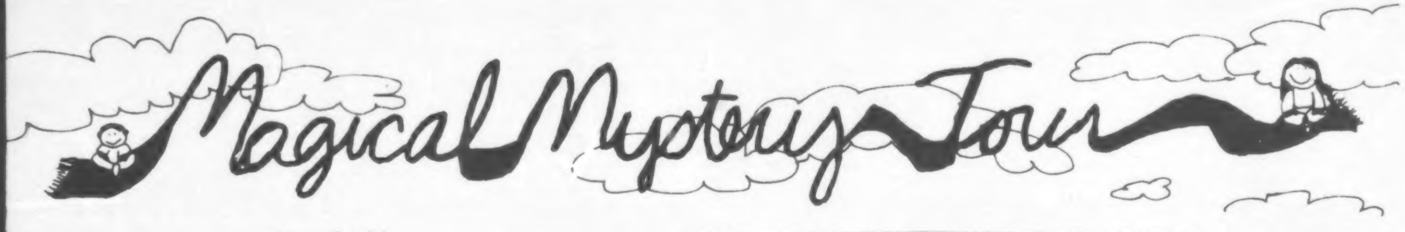
*Ask the students why this connection with the tree is so important? What do we give to the plants? (Carbon dioxide) What do the plants give to us? (Oxygen) Could we survive without plants? This exchange is the greatest deal on earth.

*Continue allowing students to ride the bike through the use of a TV game show format. Ask each contestant a question relating to the oxygen-carbon dioxide cycle and photosynthesis. Possible questions: What are you breathing out? What are you breathing in? Where does the oxygen come from? What does the leaf make with your carbon dioxide? What does the leaf release in the process of photosynthesis?

After the game, discuss human interaction with the earth's plant life. What would happen if we cut down all our forests: to people and to animals? If we run out of air, can we make it in a factory? Can we buy it at the store? How do humans change the plant supplies on the earth? (logging, cities, roads) How important do you think a place like the Amazon jungle in South America is? Why?

Adapted from Sunship Earth, by Steve Van Matre





Magical Mystery Tour

purpose

To demonstrate the production of oxygen and the utilization of carbon dioxide by plants in the course of photosynthesis.

Materials: Bottle of bromothymol blue* with stopper and straw, sprig of Elodea* (aquarium plant), rubbing alcohol, cotton.

Photosynthesis involves the exchange of the gases oxygen and carbon dioxide. When you breath into the chemical bromothymol blue, the carbon dioxide in your exhaled air changes the color of the chemical to yellow-green. When you then place a green elodea plant into the chemical and leave it in bright sunlight, the color changes back to blue as the plant consumes the carbon dioxide.

Directions:

*Demonstrate a soft, but steady breathing rhythm into the straw of the rubber stoppered bottle.

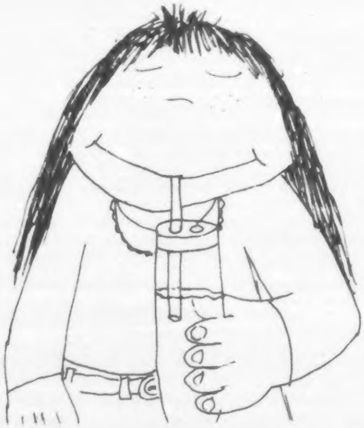
*Have different students do the same until the blue color becomes yellow-green. Use the cotton and rubbing alcohol to sterilize the straw between students.

*Plants use carbon dioxide, water, and sunlight to produce food. This is called photosynthesis. How might we turn the color from yellow-green to blue?

*Remove the stopper and place a sprig of Elodea in the bromothymol blue. Solicit predictions as to what will happen, and why.

*Place the bottle with the Elodea in bright sunlight and observe the changes over a 2-3 day period.

What would be the result of placing the plant and solution in a dark closet? Predict what would happen if the Elodea was not placed in the solution.

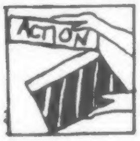


YOU LIGHT UP MY LIFE...

purpose

To demonstrate the production of oxygen by green plants.

Materials: Elodea* (an aquarium plant), two funnels, two test tubes, two containers, matches, wood sliver.



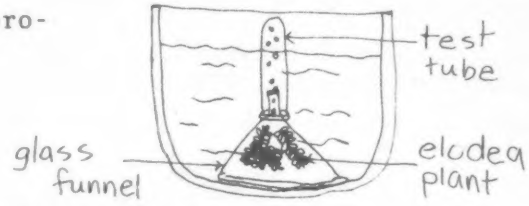
Plants take in carbon dioxide and give off oxygen in the process of making food (photosynthesis). We breathe oxygen and exhale carbon dioxide. In this way plants and animals tend to balance each other in nature.

Directions:

*Put two sprigs of Elodea in each container and add enough water to cover them as shown.

*Stir in 1/4 teaspoon of baking soda to provide a source of carbon dioxide.

*Cover the plants as shown with funnels. Rest funnels on washers or paper clips to admit air freely.



*Place a test tube over the funnel.

*Tilt the funnel and tube to fill them with water and to remove the air. Replace upright.

*Place one container in bright sunlight.

*Place the other in a poorly lit area.

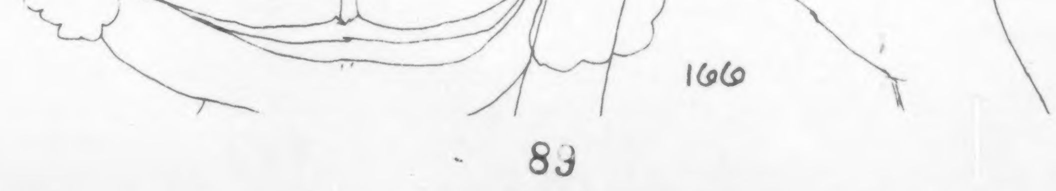
*Compare the plants daily for several days. Record any differences.

Additional Activity:

*Wait until the test tube is over ½ filled with oxygen. The water will be displaced.

*Light the wood sliver and blow out the flame. It should be glowing along the edge.

*Quickly remove the tube and insert the glowing sliver. It should flare and burn brighter from the high concentration of oxygen.



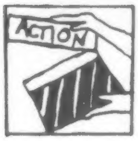
Plants Need Light Too

EVEN
"LIGHT
BULB"
LIGHT?

purpose

To demonstrate that plants need light to produce food.

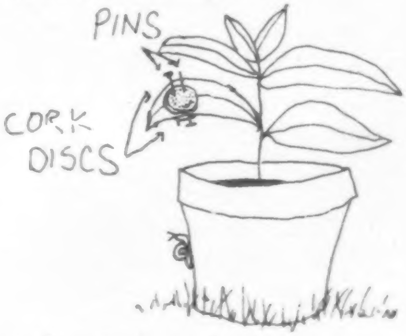
Materials: Cork, alcohol burner, pins, alcohol, two beakers, burner stand, houseplant, iodine.



Plants need air and light. Green plants make food from water in the soil, carbon dioxide gas in the air, and light. The carbon dioxide gas enters the plant through openings in the leaves. What happens if these openings are blocked?

The chlorophyll in leaves give leaves their green color. Does a plant need sunlight to make chlorophyll and stay green? Do plants produce their own food?

We can find out the answers to these questions by doing the following experiment.



*Cut two thin disks from a wine cork.

*Using pins, sandwich a green leaf on a houseplant with the cork disks.

*Place the plant in the sun for 6-8 days.

*After 6-8 days remove the wine cork from the leaf and pick the leaf.

*Light the alcohol burner.

*Place the leaf in a beaker of alcohol.

*Put this beaker inside a larger container of water and place on the burner. THE ALCOHOL BEAKER SHOULD BE HEATED IN THE WATER. ALCOHOL SHOULD NEVER BE DIRECTLY PLACED ON A FLAME.

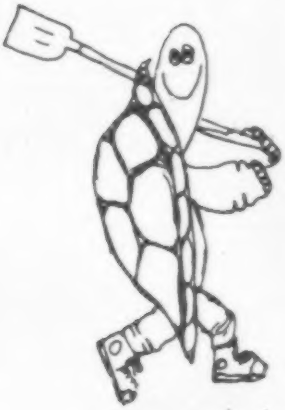
*After 15 minutes the color should have been heated out of the leaf.

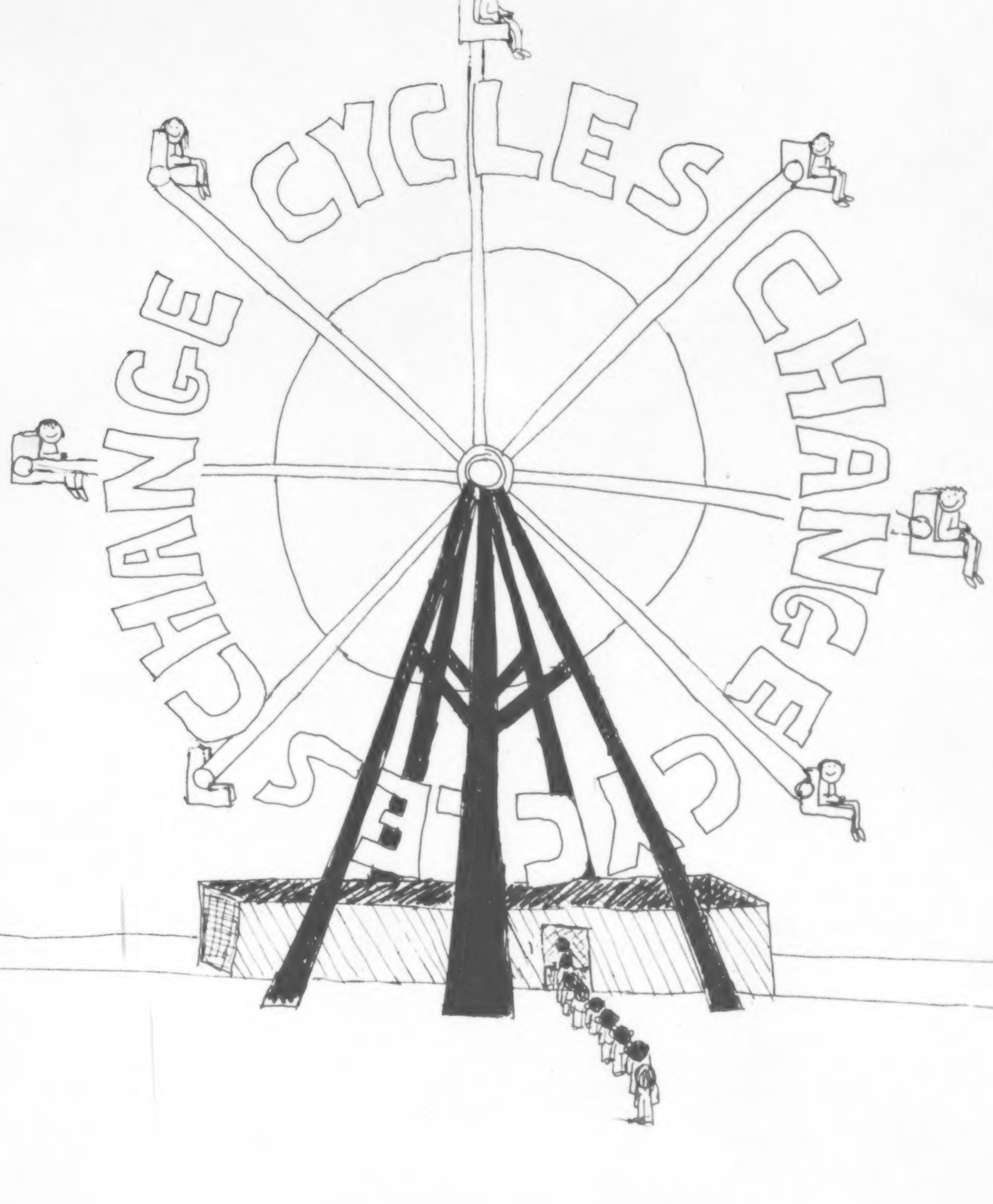
*Remove the leaf from the alcohol and rinse in water.

*Gently blot the leaf with a paper towel.

*Test the leaf for starch (food) by putting iodine drop by drop on the entire leaf. Iodine turns blue-black in the presence of starch.

Within 6 hours the leaf should turn black except over the area that the cork was covering. The cork prevented the carbon dioxide in the air from entering the leaf through the stomates. The stomates are openings through which gases move into and out of the leaf. The cork also prevented sunlight from hitting the covered part of the leaf. This prevented the leaf from photosynthesizing and producing its own food.




CYCLES
CHANGE
CYCLES
CHANGE

Cycles and changes are part of our daily lives. This unit looks at cycles and changes with a focus on decomposition and decay. The unit concludes with a selection of writings by Native Americans.

Lesson Titles	Recommended Grade Levels
The Power Of The Circle	2-6
Adopt A Tree	2-6
Dr. Jekyl And Mr. Hyde	4-6
You Look Different	4-6
Bring In The Clean Up Crew	2-6
Compost Bags	2-6
Mother Earth	4-6
This Earth Is Sacred	4-6

The Power of the Circle

CIRCLE POWER

purpose

To teach the concept of cycles.

Materials: posters of cycles: water, nutrient, seed oxygen, seasons

Write the word CIRCLE on the board. What is this word? What is a circle? Write the word CYCLE directly beneath it. What is this word? Rub out the IR of circle and write in Y. The word cycle comes fron an old word meaning circle. Cycles are just repeating circles.

Draw a circle on the board and begin tracing slowly around it. When things happen in a cycle they continue to happen in a particular order around in a circle till they are back where they started and then (re-trace the circle) they start around all over again.

The four seasons happen in cycles. Who can name them in order? Does it make any difference where you start? Why not? Write the seasons around the circle you drew on the board.

Use the SEASONS poster here. Some trees go through a cycle of changes as the seasons change in their cycle. What does a tree look like in winter? spring? summer? fall?

What other things happen in a cycle? (Possible answers: clock time, phases of the moon, tides, insect life cycle, human life cycle, paper and glass recycling, etc.) Discuss how these things happen in a circle which repeats itself.

Use the OXYGEN, NUTRIENT, and WATER posters to introduce these cycles. Discuss these cycles and their importance to our garden and ourselves.

Background

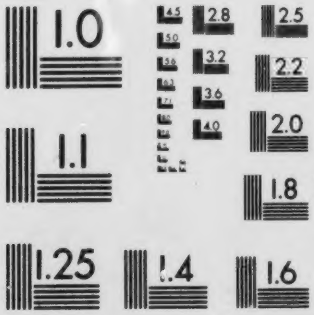
NUTRIENT CYCLE - It is an important part of a cycle that plants decompose when they die. When plants die and decay, the nutrients that the plants took out of the soil are put back into the soil to be used again and again. This is another cycle. We call this the nutrient cycle. Without this cycle all the nutrients in the soil would soon be completely used up and no more plants could grow.

WATER CYCLE - Water is part of a very important cycle. All the water that we will ever have is already part of that cycle. Moisture evaporates from the earth and accumulates in the sky as clouds. Then it is dropped, returning to the land where it again evaporates. Without this constant recycling, we would quickly run out of water.

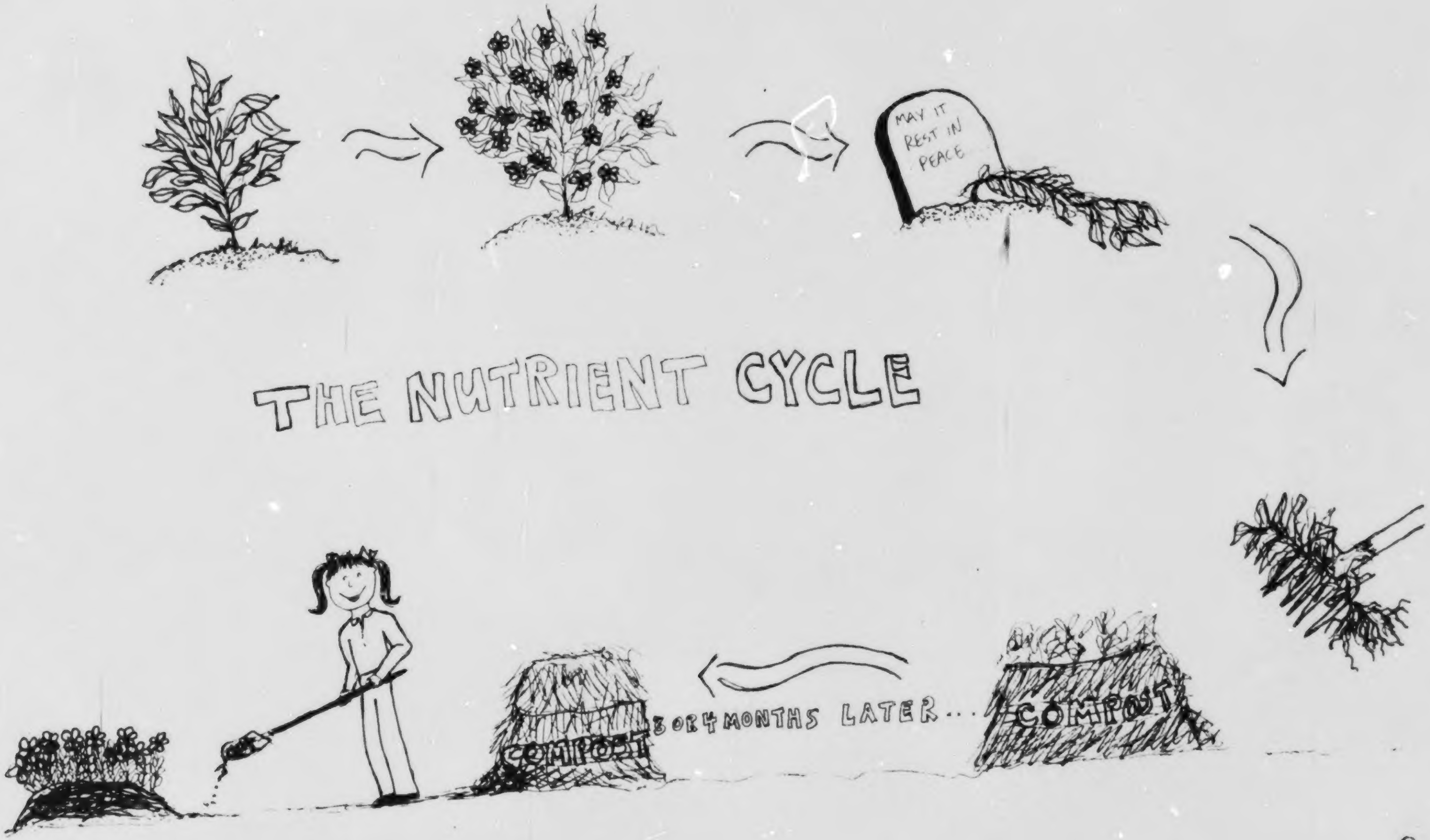
OXYGEN CYCLE - People breathe in oxygen in order to live. We breathe out carbon dioxide. Plants breathe in carbon dioxide and breathe out oxygen. We make an exchange with the plants. We need the oxygen which they can produce, and they need the carbon dioxide which we, and other animals produce. A pretty nifty deal, eh?

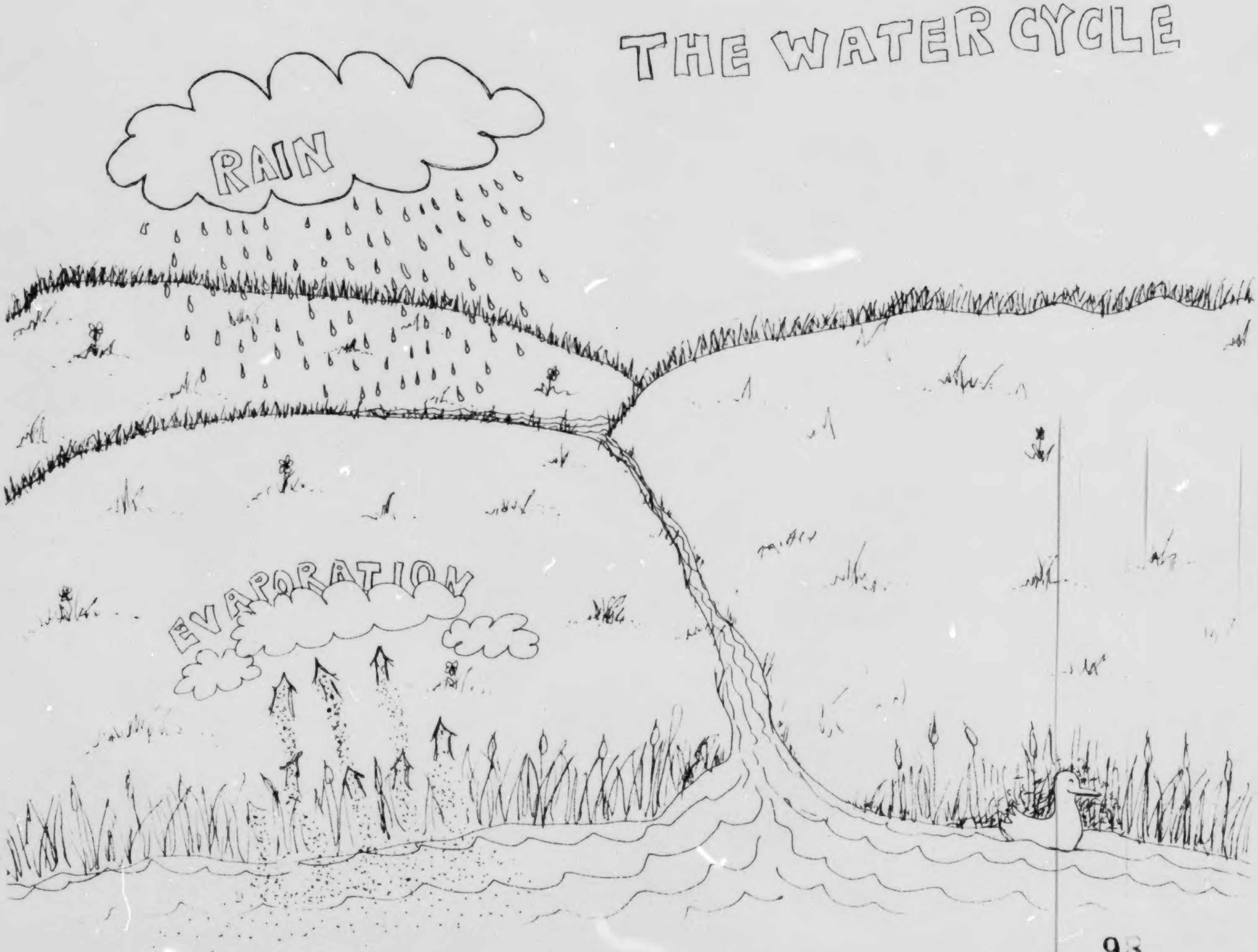
Adapted from Project Ecology,
Highline Public Schools, Seattle, WA.

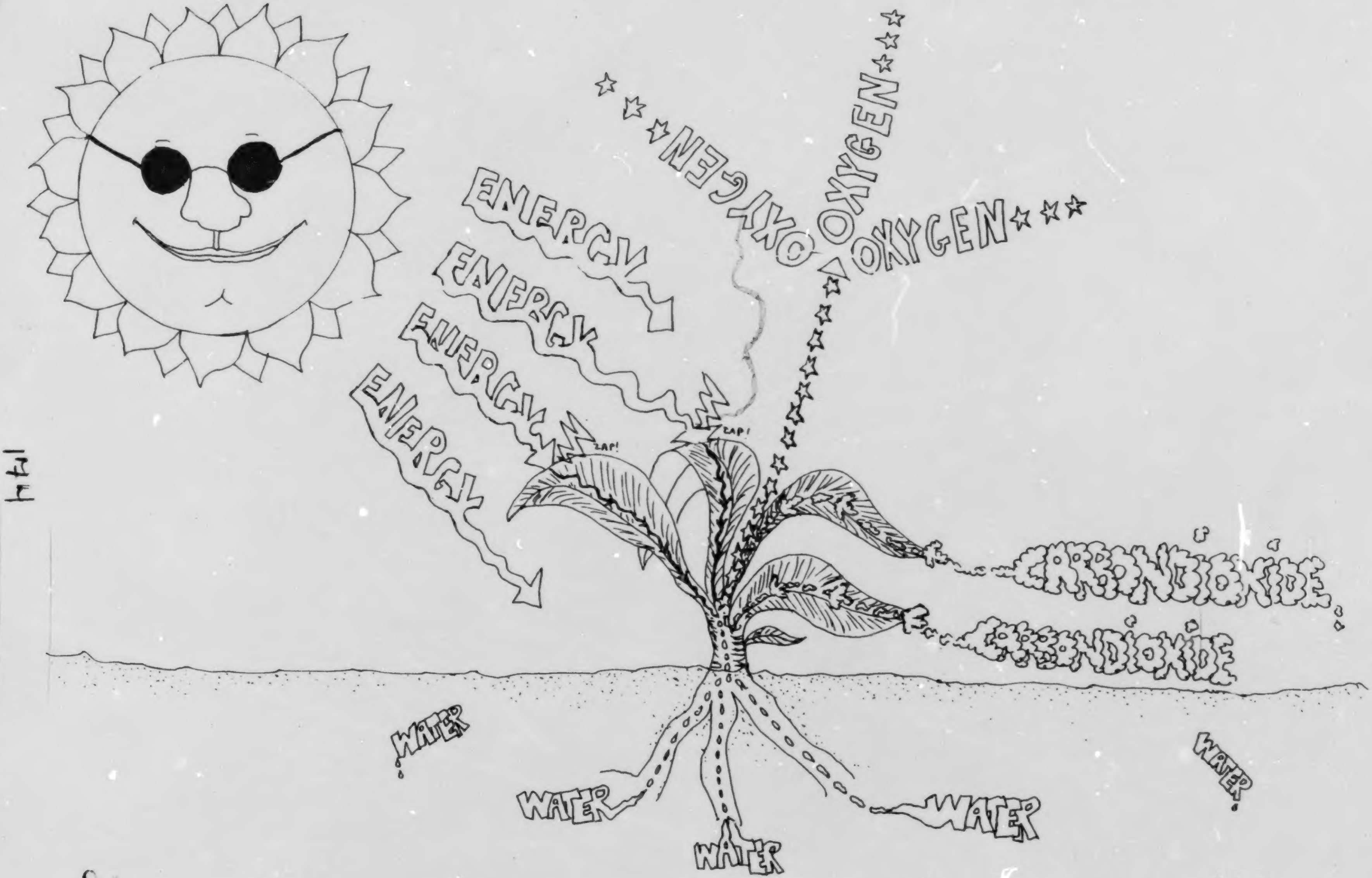
P6


1.0
4.5
5.0
5.6
6.3
7.1
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)


MAY IT REST IN PEACE
THE NUTRIENT CYCLE
COMPOST
3 OR 4 MONTHS LATER...
COMPOST


THE WATER CYCLE
RAIN
EVAPORATION


ENERGY
ENERGY
ENERGY
ENERGY
ZAP!
ZAP!
OXYGEN
OXYGEN
OXYGEN
CARBONDIOXIDE
CARBONDIOXIDE
WATER
WATER
WATER
WATER
WATER
WATER

Adopt a Tree

TAKE ME!
NO! TAKE ME!

purpose

To observe seasonal changes in the life of a tree.

Materials: journals

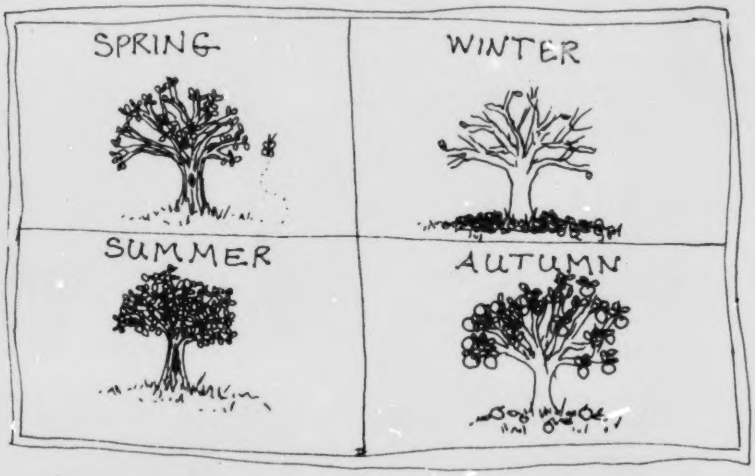
*Collectively or individually, have class members "adopt" a deciduous tree on or near school property. Observe it throughout the school year. Keep a log of changes and observations; make them every other week if possible.

*First try to get a feeling for your tree: how tall do you think it is? Wide? How many students does it take to hug a ring around the tree? What is the color and texture of the bark? Feel it: is it rough or smooth? What about the leaves? What's their color, texture, and shape? Do they smell? Listen. What sound does the wind make in the trees?

*Try to draw your tree, and a detail of one leaf. Do you notice any scars where branches have fallen off? (Why do you think they fell off?) How did the tree heal?

*As you observe your tree throughout the year, be careful to note any changes--when leaves fall (what color are they?) and buds form; when birds visit. When does your tree fruit? Does the fruit have holes? (Look inside. What caused them?) Note how the smells change throughout the year.

*Try thinking of the tree as an apartment building. Who lives on the ground level? In the upper stories? Observe any insects, lichen, moss, or other life.



Adapted from Project Learning Tree

Dr. Jekyl and Mr. Hyde

purpose

To observe how different substances change.

Materials: glass containers, clear plastic bags

Discuss with your class the concept of change. Ask students to give examples of changes occuring around them. Examples: "It was sunny this morning, now it is cloudy; I'm two inches taller than I was last year; I watched a candle burn down last night; An ice cube melted in my glass."

Have students make three lists on the board: 1. THINGS WHICH WILL CHANGE 2. THINGS WHICH WILL NEVER CHANGE 3. THINGS WHICH MAY OR MAY NOT CHANGE. Your class might come up with this list:

1.
cereal
orange peel
leaves
nails
wax
butter
bread

2
sand
glass
rubber
paper
steel wool
pencil
leather

3
pepper
salt
paper clips
mustard
dried apple

Simply record their predictions. Do not correct their placement of an item. Let them discover what will happen through observation.

Ask your students to bring in a variety of substances: those they listed, liquid and solid food, hardware, seeds, cloth, tobacco--whatever they can think of and obtain easily. Encourage them to bring in things they are not sure about. Leftover items from their school lunches would make good samples.

Once you have the samples, have the students put them individually into transparent containers that they have brought in, and they will soon begin to see some of the changes occurring. Encourage them to try and distinguish among the different kinds of changes they observe, to determine some of the possible causes, and to relate certain kinds of changes to the kinds of substances affected. Ask each student to label his or her container/s with name, sample, and date. Predictions should be written in their garden journal. Observations should be made daily.

Molds are certain to grow on some of the food items. A mold is a non-green plant that cannot make its own food. Molds reproduce by spores. These spores are so small that they can float in the air unseen. When a mold spore lands on something it can use for food, the spore grows into a new mold plant. To encourage mold growth, leave food sample exposed to the air for a half-hour. Then sprinkle each sample with water. More on this in the next lesson.

Continue this experiment until interest begins to wane. At the termination of this activity, ask students to draw conclusions regarding their sample/s. Compare this to the original predictions.

You Look Different Than the Last Time I Saw You

purpose

To demonstrate decomposition and nutrient cycling.

Materials: Petri dish with cover, soil, pieces of fruit, vegetables, bread, each no larger than ½ cubic inch; water.

ACTION

Have you ever noticed what happens to leaves when they fall off the trees? Or to the bodies of birds and animals when they die in the forest? Have you ever taken a walk in the woods and come across an old tree stretched across the path, with moss and mushrooms growing on it and hundreds of spiders and bugs making their home in it? If you have, then you have seen the beginnings of the way in which another part of the soil is made. This part, which comes from dead plants and animals, is called the organic part.

The decomposers are countless billions of small animals and plants that live in the soil, air, and water. Many of them are so small that they can only be seen with a powerful microscope. One type, called bacteria, are so tiny that one spoonful of soil can contain more of these creatures than there are people on earth.

Fungi and Molds are another type of decomposer. They are much larger than bacteria and sometimes can be seen with the naked eye. Have you ever seen an old piece of bread or fruit with mold growing on it?

The decomposers use dead plants and animals as food. When something dies, the bacteria, fungi and molds which happen to be present start eating it. They eat and grow and multiply so rapidly that in a very short time millions of them are working on the dead plant or animal. It is their eating which causes what we call decay or decomposition.

When things decay, they form a material called humus. Humus is rich in minerals and other nutrients. The humus becomes part of the soil.

So you see that even after an animal or plant dies, it is still useful. Through the action of the decomposers, the dead animal or plant supplies nutrients for future living things.

To see decomposers at work:

*Place a thin layer of soil on the bottom of the dish.

*Put three pieces of food on top of the soil. Moisten them and the soil with water.

*Cover the dish. Remove the cover for a few seconds every couple of days to let some air in.

Record the day you begin, what pieces of food you use, the day you notice a change in each of the food pieces, and how long it takes before you cannot recognize each piece of food. Describe the changes. What color is each mold or fungi? How many different kinds of molds or fungi grew? Did the same color fungi grow on the same kind of food?

Bring In The Clean-up Crew

purpose

To observe the rate of decay of various materials.

Materials: VARIOUS DE-COMPOSING AND NON-DECOMPOSING MATERIALS, SHOVEL.

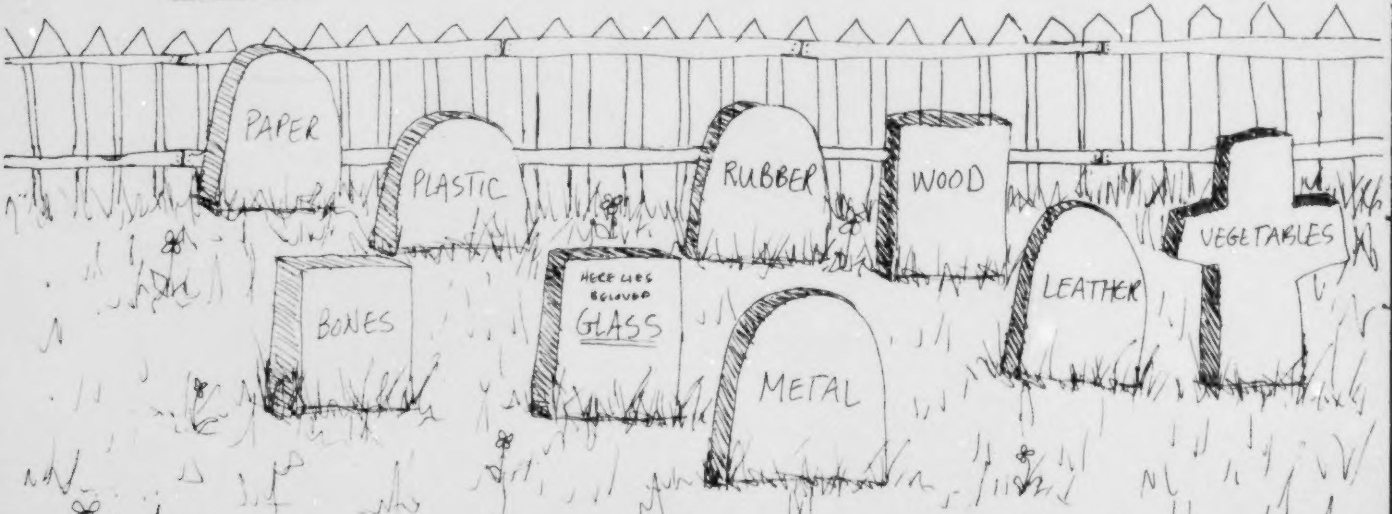
ACTION

We can learn about decay by burying different objects on the school grounds.

Make a graveyard of a variety of different materials, such as metal, glass, plastic, rubber, vegetables, bone, wood, paper, rope, leather, feathers, etc. Bury each item in a different hole, all at the same depth. Once a week dig up the items and record how fast and in what ways each is decaying. (If you think you might damage items when you dig or might have difficulty finding each one, put a screen over the material before putting the soil in the holes).

You can expand upon this by staking material the same or similar to the buried items on the surface of the soil rather than under the soil. This allows you to make comparisions about rates of decomposition when exposed to different conditions.

What factors affected the speed of decay of the various objects?



148

Compost Bags

purpose

To explore what type of materials decompose.

Materials: 1 large plastic garbage bag with closing tie, wet soil, 3 grapes, styrofoam cup, grass clippings, lettuce, 2 nails, white bread, toilet paper, whole wheat bread, journals.
For Part II: sifting screen, walnut, apple

Do this lesson one month prior to making compost in the garden.

This project should be done with the class, but without saying what will be done with it later. Curiosity is a good motivator--let the students speculate.

Prior to doing composting outdoors, you need to set up a "decomposition bag" with the class. Do not use this term with the class, as it will prematurely give away the purpose of the lesson.

*Take the large plastic bag and put a gallon of wet soil in it.

*Add the following MATERIALS:

3 grapes
5 pieces of styrofoam cup
1 handful of grass clippings
3 leaves of lettuce
2 nails
1 slice of white bread
3 squares of wet toilet paper
1 slice of whole wheat bread

The Sun will heat it up

Mold will grow.
Bugs will eat it

*Mix all these ingredients well into the wet soil, so they are distributed throughout the bag.

*Close the bag so that it is air tight.

*Mark the amounts of things inside and the date it was sealed on a card and tape it to the bag.

*Put the bag in an out of the way place in the room.

*Hang a sign on it entitled: What's Going on in Here?

Ask the students to write in their journals predictions about what will happen, or draw what they think the contents will look like in a month.

The bag should be opened outdoors at the beginning of compost-making.

It is gonna smell. It will get hard

MORE

COMPOST BAGS pt. II

One month later, or at the start of composting do the following:

*Ask your students to help you list what materials were put in the bag.

*Ingredient by ingredient, ask students to hypothesize as to what happened to each.

*Open the compost bag in the garden.

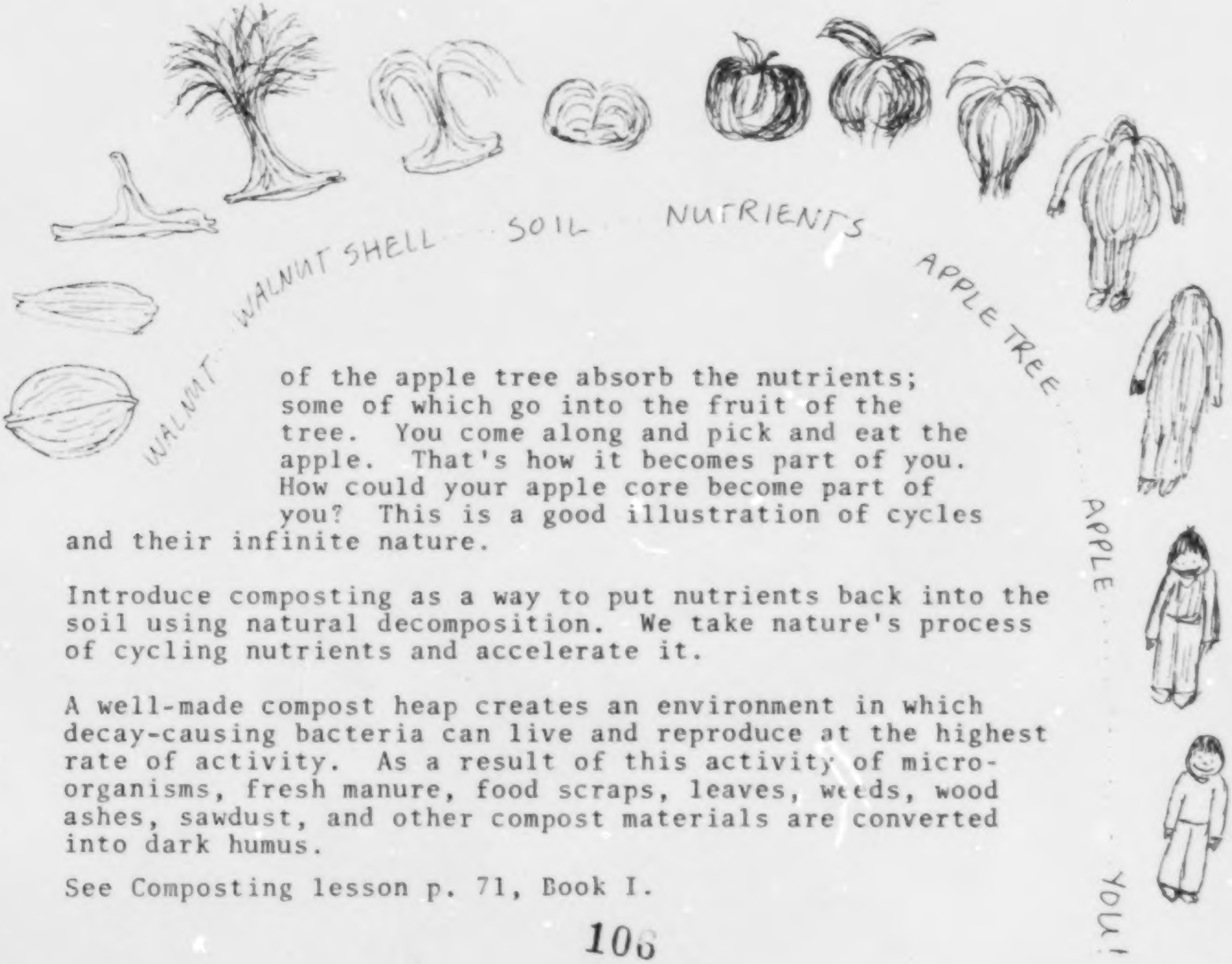
*Pass the contents through a screen.

*Make observations regarding the condition of the ingredients.

*Ask students to refer to their original predictions made in the classroom. Draw conclusions. What changes occurred?

*Discuss decomposition, decay and nutrient recycling.

*Hold up a walnut shell and an apple. Ask "How could this walnut shell become an apple and become you?" One possibility: The walnut shell is dropped under an apple tree. The walnut shell decomposes and adds nutrients to the soil. The roots of the apple tree absorb the nutrients; some of which go into the fruit of the tree. You come along and pick and eat the apple. That's how it becomes part of you. How could your apple core become part of you? This is a good illustration of cycles and their infinite nature.



Introduce composting as a way to put nutrients back into the soil using natural decomposition. We take nature's process of cycling nutrients and accelerate it.

A well-made compost heap creates an environment in which decay-causing bacteria can live and reproduce at the highest rate of activity. As a result of this activity of micro-organisms, fresh manure, food scraps, leaves, weeds, wood ashes, sawdust, and other compost materials are converted into dark humus.

See Composting lesson p. 71, Book I.

Mother Earth

The following four pages are from native American writings or speeches, and are offered here as a resource for your use.

The first Americans, the various Indian peoples, viewed trees and other living things as brothers and sisters. Trees were sacred members of the natural world deserving of reverence and respect. Should Native Americans need to cut down a tree, they would offer prayers to its spirit both before and after harming it. They would thank the tree for giving its life so that they might be able to carry on theirs.

Read and discuss the following quote from Walking Buffalo of the Stoney Tribe, Alberta, Canada.

"Hills are always more beautiful than stone buildings, you know. Living in a city is an artificial existence. Lots of people hardly ever feel real soil under their feet, see plants grow except in flower pots, or get far enough beyond the street light to catch the enchantment of a night sky studded with stars. When people live far from scenes of the Great Spirit's making, it's easy to forget his laws.

Did you know that trees talk? Well they do. They talk to each other, and if you listen they'll talk to you. Trouble is, white people don't listen. They never learned to listen to the Indians so I don't suppose they'll listen to other voices in nature. But I have learned a lot from trees: sometimes about the weather, sometimes about animals, somtimes about the Great Spirit."

In the following passage, an old holy Wintu woman speaks sadly about the needless destruction of the land in which she lived--a place where gold mining and particularly hydraulic mining had torn up the earth.

"The White people never cared for land or deer or bear. When we Indians kill meat, we eat it all up. When we dig roots we make little holes. When we build houses, we make little holes. When we burn grass for grasshoppers, we don't ruin things. We shake down acorns and pinenuts. We don't chop down the trees. We only use dead wood. But the White people plow up the ground, pull down the trees, kill everything. The tree says, "Don't. I am sore. Don't hurt me." But they chop it down and cut it up. The spirit of the land hates them. The Indians never hurt anything, but the White people destroy all. They blast rocks and scatter them on the ground. The rock says,"Don't. You are hurting me." But the White people pay no attention. When the Indians use rocks, they take little round ones for their cooking...How can the spirit of the earth like the White man?...Everywhere the White man has touched it, it is sore."

Native American Indians were very aware of the significance of circles, sensing the strength in the common roundness of a human body and a plant stem, of a teepee and a tree trunk, of the sun and the moon. Black Elk was an Oglala Indian Spiritual Man who lived in the late 1800's. Read and discuss the following writing of his with your class.

"You have noticed that everything an Indian does is in a circle, and that is because the Power of the World always works in circles, and everything tries to be round. In the old days when we were a strong and happy people, all our power came to us from the sacred hoop of the nation and so long as the hoop was unbroken the people flourished. The flowering tree was the living center of the hoop, and the circle of four quarters nourished it. The east gave peace and light, the south gave warmth, the west gave rain, and the north with its cold and mighty wind gave strength and endurance. This knowledge came to us from the outer world with our religion. Everything the Power of the World does is done in a circle. The Sky is round and I have heard that the earth is round like a ball and so are all the stars. The Wind, in its greatest power, whirls. Birds make their nests in circles, for theirs is the same religion as ours. The sun comes forth and goes down again in a circle. The moon does the same, and both are round.

Even the seasons form a great circle in their changing, and always come back again to where they were. The life of a man is a circle from childhood to childhood and so it is in everything where power moves. Our teepees were round like the nests of birds and these were always set in a circle, the nation's hoop, a nest of many nests where the Great Spirit meant for us to hatch our children."

I HAVE KILLED THE DEER

Taos Pueblo Tribe

I have killed the deer
I have crushed the grasshopper
And the plants he feeds upon
I have cut through the heart
Of trees growing old and straight.
I have taken fish from water
And birds from the sky.
In my life I have needed death
So that my life can be.
When I die I must give life
To what has nourished me.
The earth receives my body
And gives it to the plants
And to the caterpillars
To the birds
And to the coyotes
Each in its own time so that
The circle of Life is never broken.

This Earth is Sacred

The following letter, written in 1855, was sent to President Franklin Pierce by Chief Sealth of the Duwamish Tribe of the State of Washington. It concerns the proposed purchase of the tribe's land. Seattle, a corruption of the chief's name, is built in the heart of Duwamish land. The letter is printed courtesy of Dale Jones of the Seattle office of Friends of the Earth.

The Great Chief in Washington sends word that he wishes to buy our land. The Great Chief also sends us words of friendship and good will. This is kind of him, since we know he has little need of our friendship in return. But we will consider your offer, for we know if we do not do so, the white man may come with guns and take our land. What Chief Sealth says, the Great Chief in Washington can count on as truly as our white brothers can count on the return of the seasons. My words are like the stars--they do not set.

How can you buy or sell the sky or the warmth of the land? The idea is strange to us. Yet we do not own the freshness of the air or the sparkle of the water. How can you buy them from us? We will decide in our time. Every part of this earth is sacred to my people. Every shining pine needle, every sandy shore, every mist in the dark woods, every clearing and humming insect is holy in the memory and experience of my people.

We know that the white man does not understand our ways. One portion of the land is the same to him as the next, for he is a stranger who comes in the night and takes from the land whatever he needs. The earth is not his brother, but his enemy, and when he has conquered it, he moves on. He leaves his fathers' graves, and his children's birthright is forgotten. The sight of your cities pains the eyes of the redman. But perhaps it is because the redman is a savage and does not understand . . .

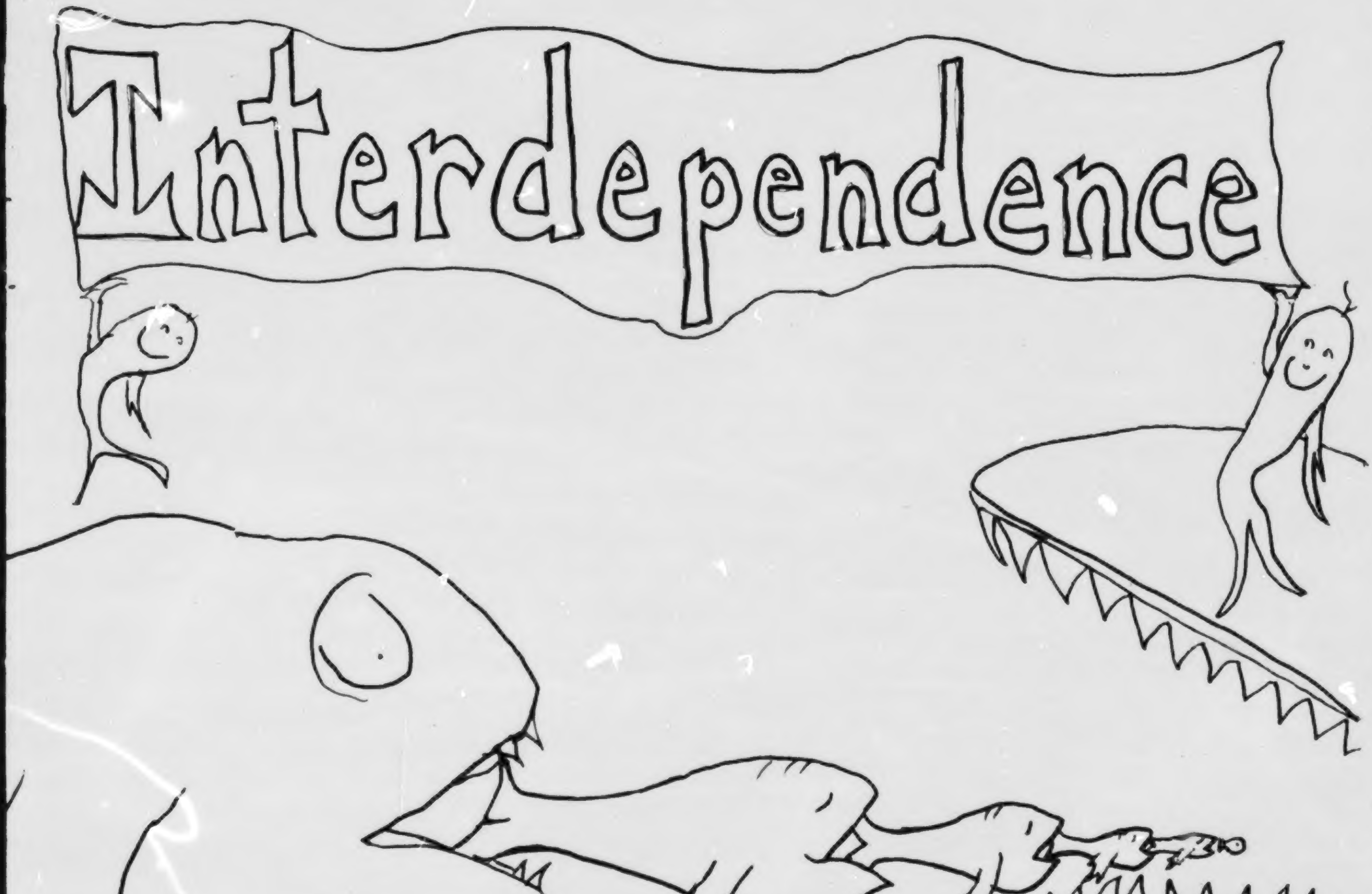
There's no quiet place in the white man's cities. No place to hear the leaves of spring or the rustle of insect's wings. But perhaps because I am a savage and do not understand--the clatter only seems to insult the ears. And what is there to life if a man cannot hear the lovely cry of a whippoorwill or the arguments of the frogs around a pond at night? The Indian prefers the soft sound of the wind darting over the face of the pond, and the smell of the wind itself cleansed by a mid-day rain, or scented with a pinon pine. The air is precious to the redman. For all things share the same breath--the beasts, the trees, the man. The white man does not seem to notice the air he breathes. Like a man dying for many days, he is numb to the stench.

If I decide to accept, I will make one condition. The white man must treat the beasts of this land as his brothers. I am a savage and I do not understand any other way. I have seen a thousand rotting buffaloes on the prairies left by the white man who shot them from a passing train. I am a savage and I do not understand how the smoking iron horse can be more important than the buffalo that we kill only to stay alive. What is man without the beasts? If all the beasts were gone, men would die from great loneliness of spirit, for whatever happens to the beast also happens to man. All things are connected. Whatever befalls the earth befalls the sons of the earth.

Our children have seen their fathers humbled in defeat. Our warriors have felt shame. And after defeat, they turn their days in idleness and contaminate their bodies with sweet food and strong drink. It matters little where we pass the rest of our days--they are not many. A few more hours, a few more winters, and none of the children of the great tribes that once lived on this earth, or that roamed in small bands in the woods, will be left to mourn the graves of a people once as powerful and hopeful as yours.

One thing we know which the white man may one day discover. Our God is the same God. You may think now that you own him as you wish to own our land. But you cannot. He is the Body of man. And his compassion is equal for the redman and the white. This earth is precious to him. And to harm the earth is to heap contempt on its creator. The whites, too, shall pass--perhaps sooner than other tribes. Continue to contaminate your bed, and you will one night suffocate in your own waste. When the buffalo are all slaughtered, the wild horses all tamed, the secret corners of the forest heavy with the scent of many men, and the view of the ripe hills blotted by talking wires, where is the thicket? Gone. Where is the eagle? Gone. And what is it to say goodby to the swift and the hunt, the end of living and the beginning of survival.

We might understand if we knew what it was that the white man dreams, what hopes he describes to his children on long winter nights, what visions he burns into their minds, so they will wish for tomorrow. But we are savages. The white man's dreams are hidden from us. And because they are hidden, we will go our own way. If we agree, it will be to secure your reservation you have promised. There perhaps we may live out our brief days as we wish. When the last redman has vanished from the earth, and the memory is only the shadow of a cloud moving across the prairie, these shores and forest will still hold the spirits of my people, for they love this earth as the newborn loves its mother's heartbeat. If we sell you our land, love it as we've loved it. Care for it, as we've cared for it. Hold in your mind the memory of the land, as it is when you take it. And with all your strength, with all your might, and with all your heart--preserve it for your children, and love it as God loves us all. One thing we know--our God is the same. This earth is precious to him. Even the white man cannot be exempt from the common destiny.


Interdependence

"When you pick a flower, you shake a star." Interdependencies are the webs that tie us and all that makes up our complex world together. This unit looks at interdependencies in the human and animal communties, with a focus on food chains.

Lesson Titles	Recommended Grade Levels
Eat The Earth	2-6
I Eat The Sun	3-6
The Sun's Restaurant	3-6
Kill'Em Dead	4-6
Refried Cattail	4-6
The Day They Parachuted Cats Into Boreno	4-6
Caught In The Web Of Life	4-6
How Many Interdependencies Can You Find?	4-6
We're Just Babes In The Woods	5-6
Lunch Bag Ecology Part I	2-6
Lunch Bag Ecology Part II	4-6

Eat the Earth

purpose

To illustrate for students the relative percentage of the earth capable of supporting human needs.

Materials: apple, knife

To illustrate for students the fragility of our life support systems, you can do the following using an apple to represent the earth:

*Cut an apple into quarters and set three of them aside. The remaining quarter represents the part of the earth's surface that is not under salt water.

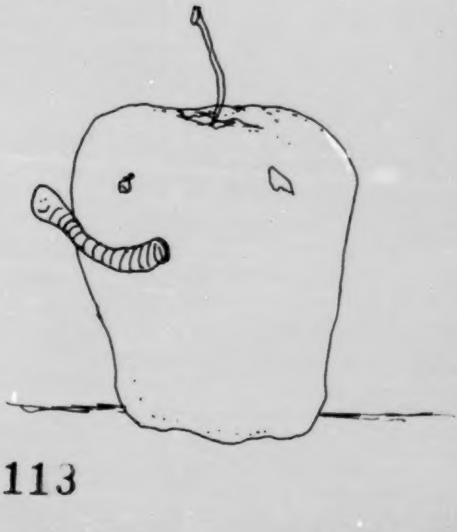
*Next, cut this quarter in half and set one piece aside. The piece in hand represents the part of the earth that is suitable for human habitation. The other part is too cold, too dry, too mountainous, or too hot.

*Now cut the last one-eighth, which represents the part on which humans can live, into four equal slices. Rather thin, aren't they? Just one of these four small slices represents the part of the earth that supplies most of our food and clothing, the small part which is presently tilled. It is not too wet, not too cold, not occupied by cities, factories, or highways.

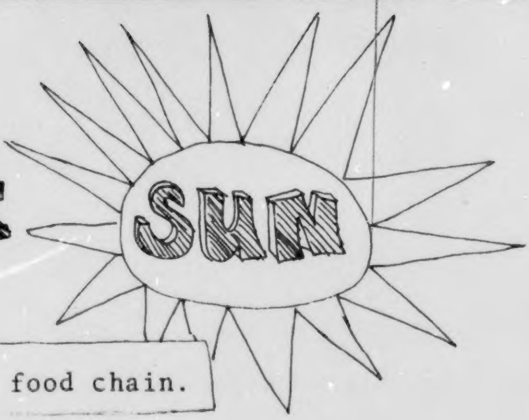
*Cut a very small piece from the last slice used above. This represents the 3/100 of 1% of the earth's surface which contains potable water. Not very much.

Our human presence on earth has been very short. In that time we have done great damage and destruction to those systems that are capable of sustaining our lives. How will we treat the remaining healthy portion?

Adapted from The Green Box, Humbolt County Office of Education



I EAT THE SUN



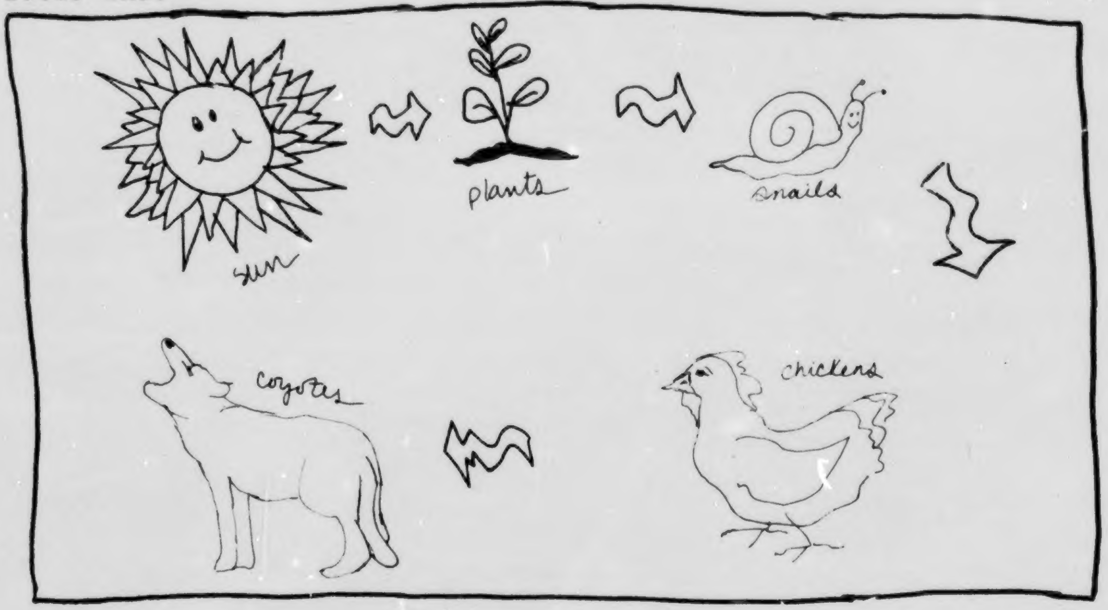
purpose

To illustrate the concept of a food chain.

Materials: 30 scrap pieces of paper with the following labels: 1-sun; 14-plant piece; 18-microorganism; 4-snail 2-chicken; 1-coyote (adjust the total to your class size).

ACTION Pass out one labeled paper to each student. Tell them to group themselves with the other students who have the same label (i.e., all 8 seeds should gather together).

When this is done, explain that a food chain is a series of organisms that depend on each other for food. Ask the groups to put themselves in the order of who feeds who.



After this is completed have each group beginning with the sun say who they are and who they feed. For example, "I am the sun, and I feed the plants". Who does the coyote feed?

Why are there more worms than quail? How can this chain be broken? How could this become a cycle? Can you name a food chain that we are part of?

The Sun's Restaurant

purpose

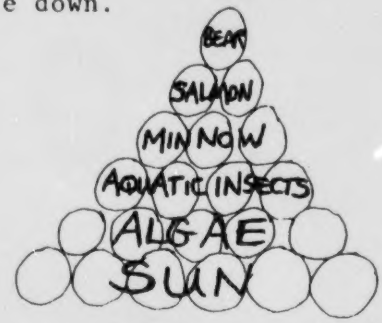
To illustrate the concept of a food chain.

Materials. 21 paper plates with the following labels: 1-bear; 2-salmon; 3-minnow; 4-aquatic insects; 5-algae; 6-sun.

ACTION

The sun's energy flows through many links in the plant and animal world. These interrelationships form food chains and in turn complex food webs on our planet. The plants and animals that depend on each other for food each form a link in the food chain.

*Place the plates in the following pyramid shape on a table or the ground. Keep the labels face down.



*Turn over the bear plate. Discuss what a bear might eat when it's hungry. In this food chain it eats salmon. Turn over the next two plates which read "salmon"- why does the bear need two salmon? Continue this line of discussion down the food chain, turning over the plates representing the next organism on the food chain.

*Emphasize in discussion the point that the food chain forms a pyramid where it is necessary to have more organisms at the base of the food chain. Also stress that the sun is the source of energy for the plants, which in turn make their own food.

List the organisms in this food pyramid that would be affected by death of the algae? How would they be affected? What would happen to the bear if this stream dried up?

Adapted from Sunship Earth by Steve Van Matre.

Kill 'Em Dead

NASTY STUFF

purpose

To illustrate the passage of insecticide through the food chain.

Materials: string, 8 jackets

Select eight students and set them in a row facing the rest of the group. As they sit there, explain to them and the others that you are the owner of a small farm in Santa Cruz County. Your main crop, apples, has been attacked by small insects which threaten your prospects of a good harvest. Taking the necessary steps to save your harvest, you finally buy a pesticide from the "Sure Getum" chemical company.

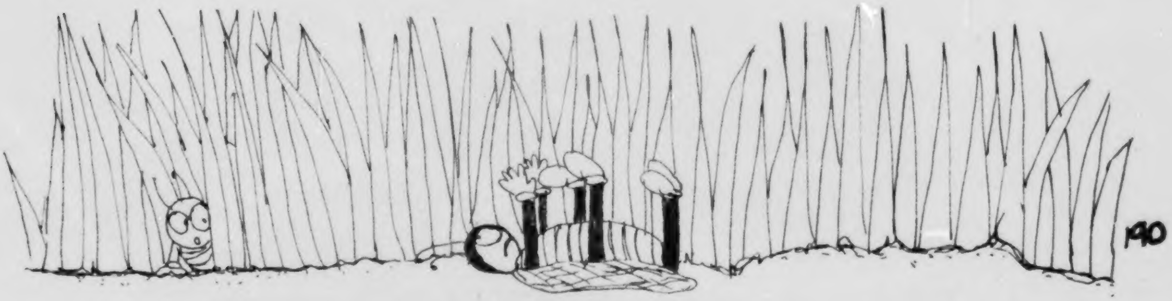
*As you tell the story, give each of the eight students a jacket. The students you have selected will be the insects and the jackets will represent the chemical with which they have been sprayed. They are now dead.

*Have four students sit down facing the dead insects. These four will be mice and each mouse will eat two insects. As they eat the insects, they remove the jackets and put them on signifying the passage of the chemical from the insects to the mice. Each mouse is now wearing two coats, i.e., two units of spray.

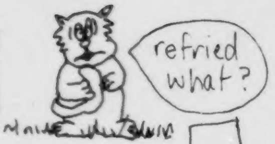
*Select two students to sit behind the four mice. These two will be gopher snakes and each gopher snake will eat two mice. As the mice are eaten, their jackets are removed and placed upon the gopher snakes. Again, we have the passage of the chemical from one organism to another and each snake should now be wearing four jackets.

*Select one student to represent an eagle. The eagle will eat the two snakes, acquiring eight jackets and will then die.

What do the eagle's eight jackets represent? How did the eagle acquire the jackets (pesticide)? It is a fact that all Americans have DDT, a banned pesticide, in their body fat. Explain how it got there. Propose an alternative to the heavy use of chemical pesticides in farming.



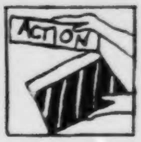
Refried Cattail with Filet of Beaver Tail


refried what?

purpose

To illustrate interdependencies within a food web.

Materials: string



Assign students an animal or plant from the accompanying chart. Have each one make a sign showing the name of their animal. If you wish, each child can research his/her plant or animal to find out more about it. When this is completed tape the signs to the front of each desk, and arrange the desks in one large circle. Pick any animal (not a plant or decomposer to start with), and hand the child the end of a ball of string. Then ask him or her to pick something from the circle that their animal would like to eat. Run the string from the first student to the second. Continue this until all children have at least one part of the string in their hands. You may have to help them understand that plants "eat" the products that decomposers break down. Also, decomposers eat dead things. Encourage the decomposers to choose to eat animals such as mountain lions and vultures which are eaten by nothing else. Continue until your food web is too complex to take any further.

Any of the possible scenarios can be introduced to illustrate John Muir's axiom, "When we try to pick out anything by itself, we find it hitched to everything else in the universe."

a. Air pollution kills all of the trees.
b. Flooding inundates the area.
c. DDT wipes out the insects.
d. Hunters eliminate the mountain lions.
e. The area is stripmined.
f. add your own....

The student's roles directly affected by a given change can drop hold of the string, or the string can be cut. Discuss the collapse of the web.

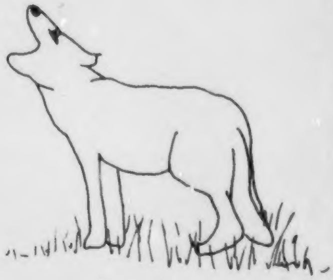
What was the result of making a change in the web? Identify ways we are causing changes to the earth? Name an action you have taken that resulted in an unexpected change.

FOOD WEB CHART

COYOTE
MOUSE
RABBIT
SNAKE
GRASS
OWL
SNAIL
DEER
RACOON
VULTURE

FISH
EARTHWORM
SPARROW
ROBIN
BEAR
SALMON
MOUNTAIN LION
BEAVER
LIZARD
GOPHER

ALGAE
OAK TREE
CATTAILS
HAWK
GRASSHOPPER
DUCK
BEETLE
MITE
FLY
MAN



The Day They Parachuted Cats Into Borneo

purpose

To demonstrate the ramifications of making a single change in an ecosystem.

Read aloud the following true story to your students, and discuss.

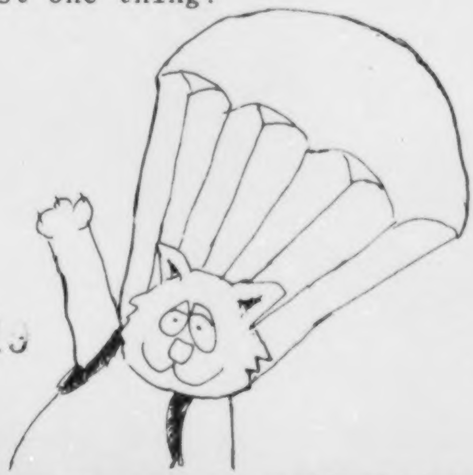
Some time ago, the World Health Organization sent supplies of DDT (explain that this is a chemical designed to kill pests that is no longer allowed to be used in this country because of its ill effects on other forms of life) to Borneo to fight mosquitos that spread malaria among the people. The mosquitos were quickly wiped out. But millions of roaches lived in the villages and they simply stored the DDT in their bodies and went scurrying off into the dark places. One kind of animal that fed on the roaches was a small lizard. When these lizards ate roaches, they also ate a lot of DDT. Instead of killing them, DDT only slowed them down. This made it easier for cats to catch lizards, one of their favorite foods. And all over North Borneo cats died from DDT.

Then the rats moved in because there were no cats to control their population. With the rats, came a new danger; plague. Officials sent out emergency calls for cats. Cats were sent in by airplanes and dropped from the sky by parachute.

Then the roofs began to sag and cave in. Now what? The people once again began to search for the cause. They found it in the hordes of caterpillars that had moved in to feed on the roofing materials. Why? The lizards were gone, and the lizards, as well as the roaches ate caterpillars and had kept them in control. One simple change in the ecosystem had set off a whole chain reaction.

From Laycock, Let the Wild Ones Stay Home.

Have students identify actions they or others have taken that caused unexpected changes or outcomes. What happens when we change just one thing?



Caught in the Web of Life

purpose

To have students examine dependencies in their community and on the school site.

Think of all the different people who contribute to the school. Have the students list who these people are. As they suggest them, write them on the board in a circle. Starting with one, ask if this person needs or depends on any other person listed on the board. If there is a dependence established, draw a line connecting the two. Continue until you go all the way around the circle. What have you ended up with? What if one of the people in your web wasn't there any longer? What would the effects be?

Now do a web of community occupations. Gather a list of different occupations (the jobs of your students' parents could be used) that people have in your community. Write them on the board in a circle and again draw the lines that connect one with another as an interdependency is created. Try taking one away (e.g., garbage collectors). What happens?

Any community, natural or human, is composed of producers, consumers, and decomposers.

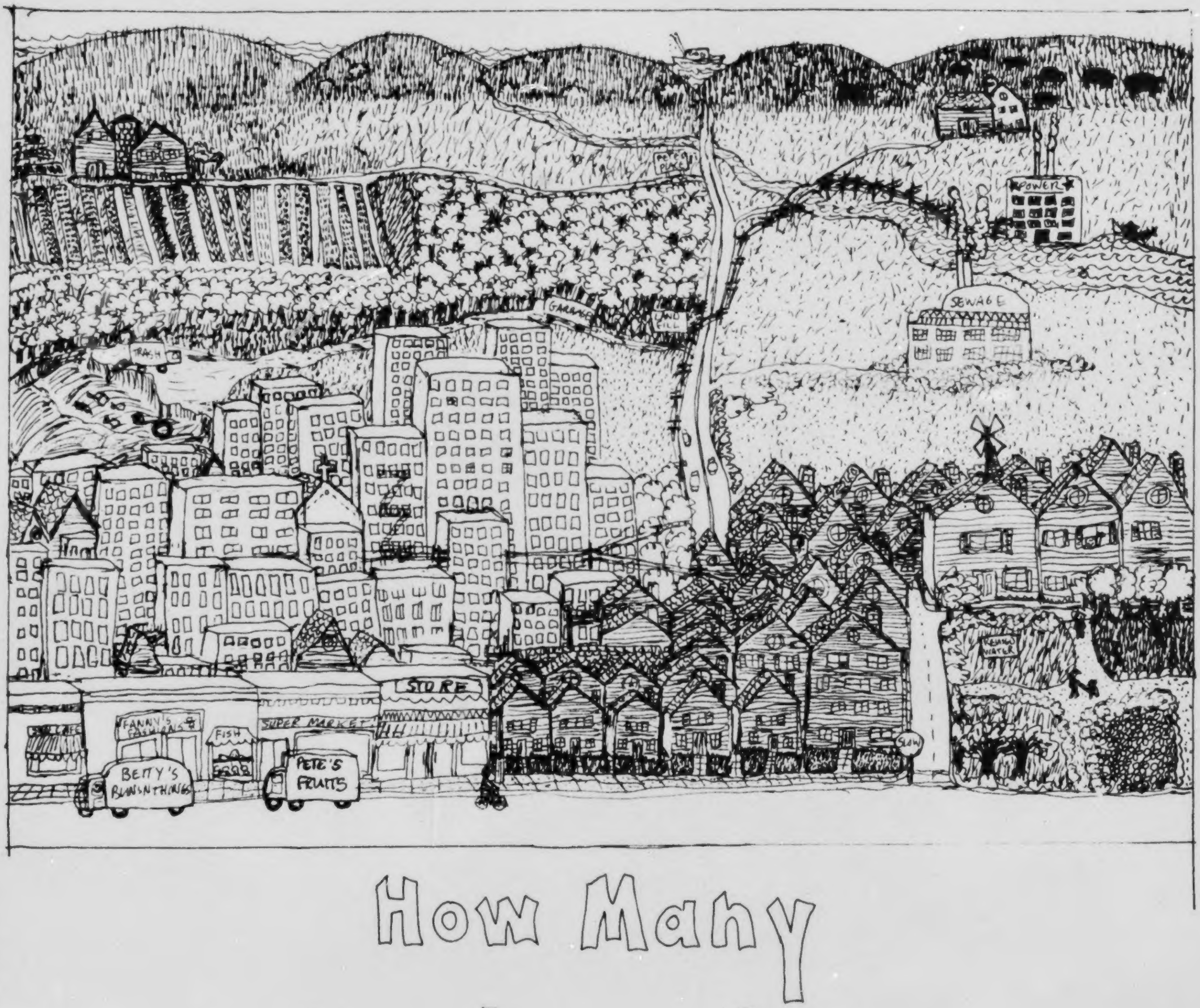
Producers - green plants which convert the sun's energy to food.
Consumers - animals who eat the green plants, or eat other animals.
Decomposers - plants or animals who eat dead producers and consumers, breaking down and recycling them in the process.

Introduce these concepts, and give examples of each. Ask the students to come up with examples drawn from natural communities. You may have to help them understand that plants "eat" the products that decomposers break down.

Now return to the human community of the web and list the human producers, consumers, and decomposers, and their needs. For example:

	BASIC NEEDS
HUMAN PRODUCERS FARMERS	PLANTS, SOIL, WATER, SUN, AIR, FERTILIZER, LIVESTOCK
HUMAN CONSUMERS PEOPLE CAR	FOOD, SHELTER, CLOTHES, SUN, AIR WATER, GAS, CARE
HUMAN DECOMPOSERS GARBAGE COLLECTORS SEWAGE TREATMENT PLANT LANDFILL/DUMP RECYCLING CENTER	GAS, WATER, ELECTRICITY, SOIL, WATER AIR, SUN, ANIMAL DECOMPOSERS

List the effects of a garbage collector strike. Identify the kind of workers who would lose their jobs if everyone stopped using cars tomorrow. What would happen in the natural world if there were no decomposers?


PETE'S PLACE
POWER
SEWAGE
GARBAGE
LAND FILL
TRASH
WATER
STORE
FANNY'S FASHIONS
FISH
SUPER MARKET
BETTY'S BUNSNTHINGS
PETE'S FRUITS
SLOW

How Many Interdependencies Can You Find in This Picture?

195

We're Just Babes in the Woods

purpose

To illustrate for students the relative time that humans have been present on earth.

Materials: stakes, colored flags

Suppose we reduced the history of the earth to a walk of 300 feet (i.e. football field). As we walked this 300 foot path, individual events representing the sequence of earth's evolution would be marked on the path with colored flags. At what point do you think humans will appear?

Beginning our walk through time we see no life for 79 feet. At the 80 foot line single celled life appears. We move on to the 125 foot point at which time the first vertebrates are seen. The first land plants appear at 160 feet. The first land vertebrates, the amphibians arise at 190 feet.

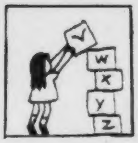
Dinosaurs march onto the scene at 215 feet and remain until 270 feet. In the meantime, the first birds and mammals appear.

The Grand Canyon is formed at 290 feet. With Only 10 feet remaining, humans have not been seen. Finally with 1 foot remaining, at 299 feet, the first human like creature shows up. At 299 feet, 8 inches, stone age people appear. At 299 feet, 11 inches the calendar begins and civilized people make the scene. Within the last inch, Columbus discovers America and the Declaration of Independence is signed.

Life has existed on earth for some 200 feet of our walk: humans have been here for less than 12 inches. The Dinosaurs dominated the walk for 55 feet; we have dominated it for less than two inches. Yet sometimes we look condescendingly upon the dinosaurs as unsuccessful animals that could not adapt. If the path were to continue into the future will it show us here 55 feet from now? What have we done to the earth in our short time here? What can we do to insure that we will continue to survive?

196

MORE



If you prefer to do this indoors, read the following to your students:

The term, "one million years," is so far outside our experience as to be meaningless to us. We may have the vague impression that a million years is a very long time.

Imagine a moving picture taken of earth by inhabitants of another planet using a super telephoto lens and a time lapse camera. This imaginary film was taken at the rate of one picture per year for the last 757 million years. When it is run in a projector at normal speed (24 pics. per sec.), 24 years of earth history flashes by each second. Since the author has the film running continuously 24 hours a day, about two million years of past history are shown on the screen each day. To show the entire 757 million years, requires running the film for one full year. The author starts the show at midnight of one New Year's Eve and runs it without interruption until midnight of the next New Year's Eve.

Throughout January, February and March, the movie runs on without showing any signs of life upon the earth. Single-celled organisms appear early in April; many-celled ones later in that month. Late in May come the first vertebrates. It is the middle of July before the first land plants begin to pave the way for animal life on land. Late August arrives before the first land vertebrates, the amphibians, put in an appearance. The first reptiles appear by the middle of September. Among them are the dinosaurs that dominate the scene through the remainder of September through October and much of November (about 70 days). In the meantime, the first birds and first mammals appear. The raising of the Rocky Mountains near the end of November, signals the end of the great era of reptilian domination.

As the movie runs on into December, we see the mammals dominant; they undergo their great evolutionary developments. Christmas arrives: The movie shows us the Colorado River beginning to cut its Grand Canyon. We have the vaguely uneasy realization that the year is nearing its close, yet we have seen no signs of man. Day follows day until we reach the last day of the year. Sunddenly, about noon of December 31, the movie shows us the first man. During the afternoon, the glaciers push southward from the polar regions and then retreat, four successive times. By suppertime, man is still not much in evidence. By about eleven o'clock in the evening, varied old stone age men and women become quite prominent in the picture, and by 11:45, men who make more refined stone implements and cultivate the soil appear. Five or six minutes before the end of the movie, the Christian era begins. Twenty seconds before the end, Columbus discovers America. Seven seconds before the end, the Declaration of Independence was signed.

Life has existed on earth for some eight months of movie's year; humans have been here for about 12 hours of that year. The dinosaurs dominated the movie for 70 days; humans dominated it for about one-half of one day, so far. If the movie continues into the year, will it show us here seventy days from now?

Adapted from The Green Box, Humbolt County Office of Education

Lunch Bag Ecology part I

purpose

To illustrate our interdependence with plants and animal life.

Materials: students' bag lunches

Children are often divorced from any comprehension of food origins. This activity quickly clarifies our interdependencies with other forms of life.

*As children begin their lunch, ask:

Who is eating roots? Who is eating leaves? (carrots, lettuce)

Who is eating something from a tree? (apple, orange)

Who is eating ground baked grass seeds? (bread)

Who is eating bird, cow or pig for lunch? (chicken, butter)

*To develop broader concepts of food chains, ask:

Who is eating water? (raw fruit or vegetable)

Who is eating sun? (trapped light, e.g., in green leaves)

Who is eating soil? (minerals in foods)

Who is eating manure or compost? (used as fertilizer on your vegetables)

I'M EATING SUN? I THOUGHT IT WAS A TUNA SANDWHICH
SALLY 1st grade

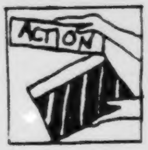
Adapted from Manure to Meadow to Milshake, Hidden Villa, Inc.

Lunch Bag Ecology part II

purpose

To explore the food supply system.

Materials: students' bag lunches



Have each student select a lunch item and explore the following:

*What season was it probably harvested or butchered? If your food was not picked recently, how was it stored? (dried, canned, bottled, frozen, pickled, stored in root cellar or attic) If we are unable to preserve and store foods from seasons of great harvest, (winter, spring), what would happen to our population after lean harvests?

*Transportation has helped man transcend local seasonal limitations. Who has lunch food grown in another climate and transported here? Where is the food from? How far has it traveled? In what season was food raised? Who has a lunch that traveled over 1,000 miles?

Example: Danish crackers, Florida oranges, New Zealand lamb, Guatemalan bananas.

Who has a lunch that has traveled less than 500 miles? What would our lunch consist of today if we ate only fresh foods? Could we eat bread in the winter? Apples in the spring? What would the California Indians have had for lunch today? Make a menu.

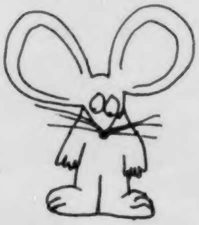
Example: Mint or sassafrass tea, smoked fish, trail snack: dried chia seeds, madrone berries and blackberries.

*What farming techniques manipulate climate to increase plant food production? Find a food in your lunch that is affected. For instance:

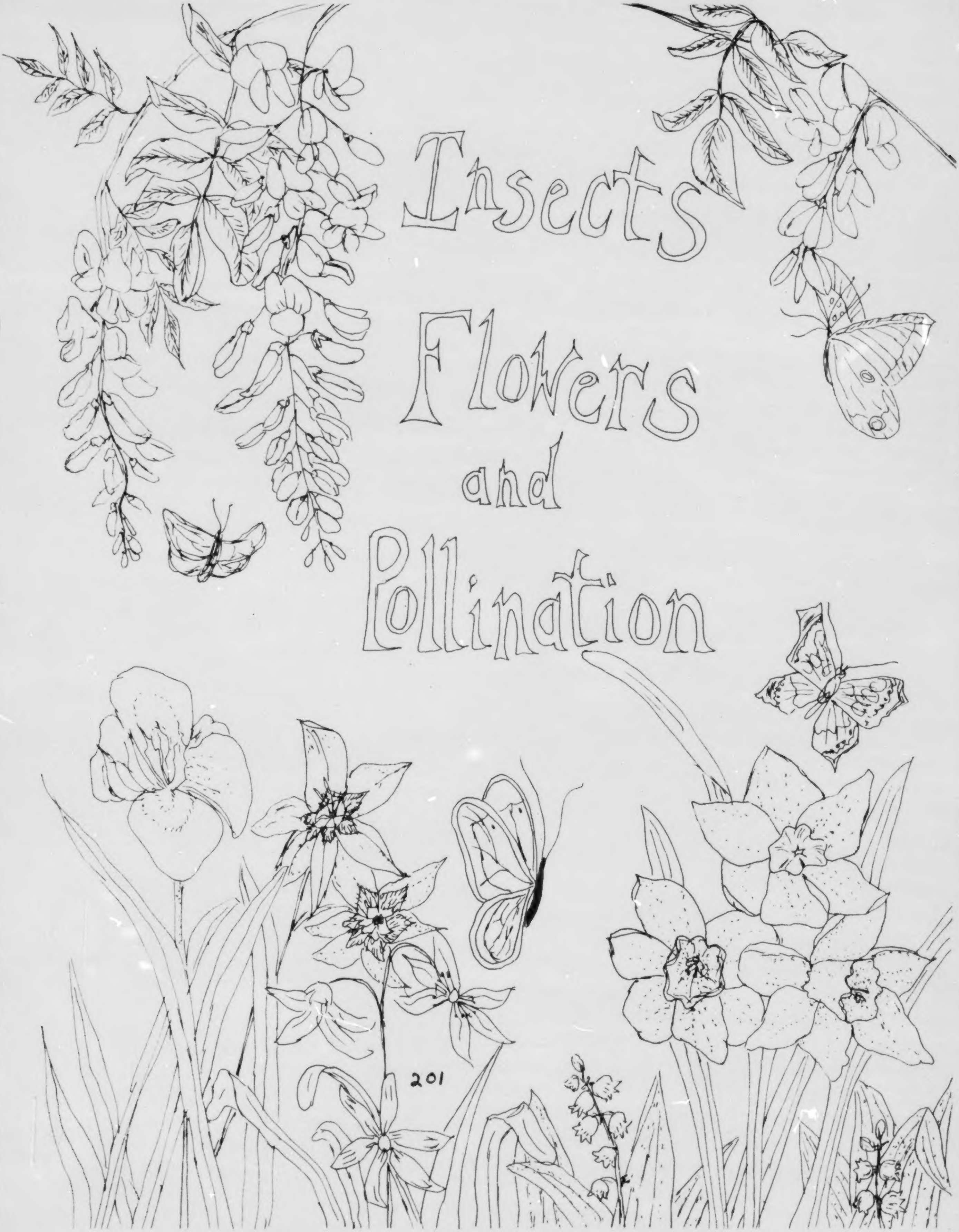
Irrigation of fruit and vegetable crops during the hot dry California summer.

Smudge pots and fans to prevent winter frost from killing citrus crops.

Greenhousing: creating summer in winter for tomatoes and flowers.



Insects Flowers and Pollination



This unit provides an introduction to the ecology and anatomy of insects and flowers. Their interrelationships are varied from protection to food to pollination. As we explore these dynamic roles of plants and insects we discover the discipline of Integrated Pest Management and how the study of the interrelationships between plant and insect can lead to a healthy, pest controlled garden. This unit applies many of the concepts learned in Cycle and Changes and Interdependence.

Lesson Titles	Recommended Grade Levels
Teacher Information - Pest Management	Teacher Information
Flower Power Part I	4-6
Flower Power Part II	4-6
Magic Spots	3-6
Garden Puzzle	3-6
Plant Architects	4-6
I Need My Space	2-6
Poisoned Darts	4-6
Earth, Planet of the Insects	2-6
Charts of Beneficial/Harmful Insects	4-6
Insect Anatomy or Make No Bones About It	4-6
Bitecycle	4-6
Who Lives Here?	4-6
On Your Mark, Get Set, Get Slimy!	2-6
Buggy Diner	4-6
Ladybug, Ladybug, Fly Away Home	4-6

Special Materials & Where To Find

Ladybugs - Can be ordered from insectaries including:

Rincon Vitova Insectaries
P.O. Box 95
Oakview, CA 93022

Gambussia Fish- Are predators of mosquitoes. They are available for free from your Mosquito Abatement District listed in the white pages of your telephone book (in California).

*The above material is listed to assist you in locating it. All materials are listed with each lesson and most are readily available.

This unit was written with the assistance of Kay Thornley and Thomas Whittman and the advice of Professor Stephen Gliessman, University of California Santa Cruz and R. Muffet Wilkerson and Peter Stoddard of the California Department of Food and Agriculture.

TEACHER INFORMATION
PEST MANAGEMENT

In our garden we continually try to replicate nature. We copy the nutrient cycle by making compost; we mulch to keep moisture in and avoid compaction just like the forest; we water to mimic a spring rain. And in our garden we are able to observe the cycles (from seed back to seed), and changes (from germination until decay), and the interdependencies (pollinator and pollen), that are the basic components of nature.

Thus, when we are asked how we control garden pests, we refer people to Integrated Pest Management (IPM). IPM is a pest management system that uses principles of our environment to control insect problems. Lessons in this unit not only introduce the parts of flowers and insects, but also demonstrate the basic principles of IPM. These lessons will provide a relevant application of the concepts learned in the two previous units "Cycles and Changes," and "Interdependencies."

It is critical for the farmer (as well as the gardener) to produce as healthy a crop as possible. It is critical to avoid a buildup of chemical pesticides in our environment (p. 190). IPM offers steps to achieve both of these goals. Its methods are based on the following premises:

*1. Every insect is not a pest.
*2. The food chain is a means of pest control. Herbivores are pests in the garden. Insects and other organisms that feed on herbivores provide a natural control of plant-eating insects.
*3. Planting a variety of crops in an area improves weed and insect control.
*4. It is necessary to identify and monitor insect damage before spraying. Not all insect damage is a problem.
*5. Sprays derived from plants or bacteria can control insect damage.
*6. Pest management methods are specific to particular stages of the pest's life cycle.

For more information on IPM contact: Department of Food and Agriculture; Pest Management, Environmental Protection. and Worker Safety; PMAP Program; 1220 'N' Street; Sacramento, CA 95814; or your County Agricultural Extension Program.

Related information and lesson on IPM appear in The Growing Classroom on pages: 28-30; 38-39; 82-83; 188-193.

Flower Power Part I

whats every shade and every hue
huge and tiny, medium too
all so different

yet quite the same
for whom rose
is only one name?

Each flower seems so unique, with its own special beauty. But they are all composed of the same parts. You and your friends are all unique, but you all have the same parts too: eyes, ears, nose, fingers, horns...oops!

purpose

To learn the parts of flowers.

Materials: journals

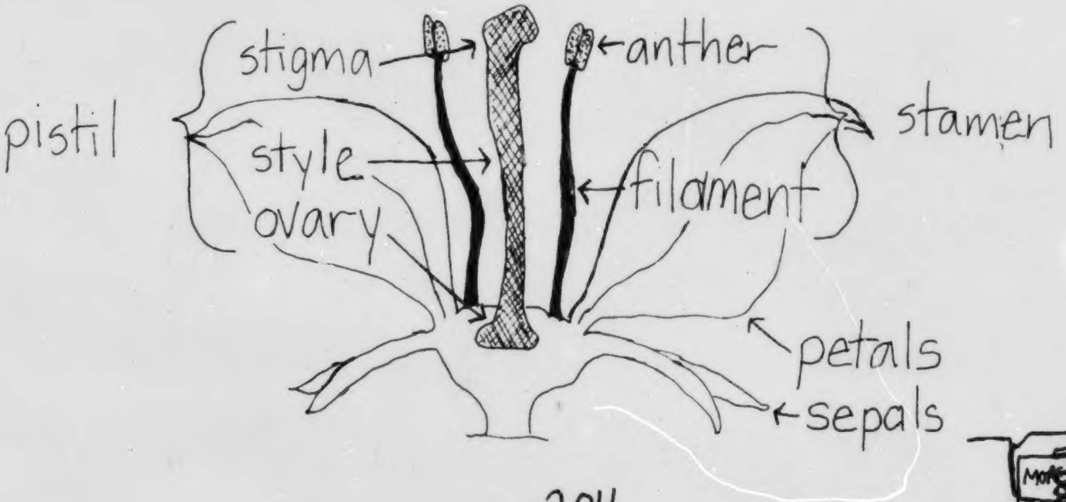
This game has students dissect and draw flowers to learn about their parts.

*Each student should go into the garden and carefully collect one flower, preferably one that nobody else has. (If there aren't enough flowers to go around, have students share).

*When they are reseated, ask them to look carefully at their flower, then spend five or ten minutes drawing it and coloring in.

Now let's look in a little more detail!

*Ask the students to gently take their flowers apart and draw each part. Use this drawing as your guide to flower parts, and discuss the function of each part.



MORE

Students should examine, draw and label the sepals, petals, pistil, and stamens.

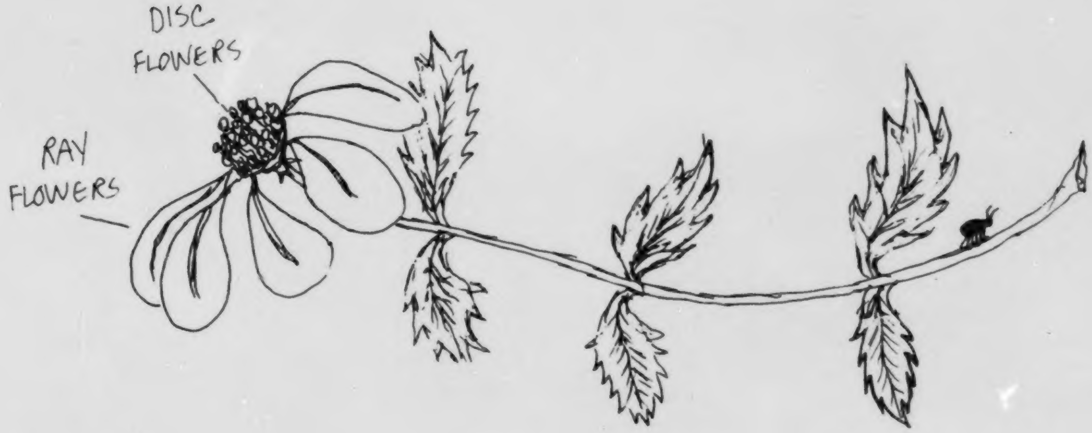
Sepals bracket the petals, and are usually green and photosynthetic (produce food from the sun).

Petals can be all colors and shapes and smells, and serve to attract pollinators.

The Pistil is the female part and is composed of the stigma, style and ovary. Male pollen lands on the stigma, travels down the style, and fertilizes the egg in the ovary. The ovary is the site of fruit and seed formation.

The Stamen is the male part, and is composed of an anther and a filament. The stamen is where pollen is produced. Usually the pistil is in the center of the flower and the stamens are all around it.

> Note: members of the daisy family (Compositae or Asteraceae) have composite flowers: the "disc" flowers in the center and the "ray" flowers (that look like petals). Each disc and each ray is a separate reproductive unit, with its own pistils and stamens, though many of them are actually sterile.



What is the name of the pollen—bearing (male) part of the flower? the female part? What part of the flower swells to become the fruit and seeds? List the things that would change if, starting tomorrow, there were no more flowers.

Flowers are the reproductive parts of plants. Their beauty and sweet smells attract the birds and insects that help spread pollen to other flowers.

Who exactly are the pollinators? Let's zoom in on them in Flower Power, Part II.

Flower Power Part II

HAVE YOU HUGGED A FLOWER TODAY?

purpose

To learn about pollinators and their relationship with flowers.

Materials: pins (to attach tags to students), construction paper

By impersonating flowers and pollinators, students learn that there is a great variety of pollinators, and that each has a special relationship with certain kinds of flowers.

The following can be read to students to introduce the lesson:

Unlike animals, plants can't move from place to place to find their mates. How then does the pollen from one flower get to the pistil (female part) of another flower?

That's where the pollinators come in. A pollinator is anything that helps spread flower pollen. There are all kinds of pollinators: birds, bats, bees, bugs, and more! (Even the wind is an important pollinator.) Pollinators drink nectar from the flowers, and some (like honeybees) collect and eat the pollen, too. In the process they spread pollen from flower to flower, without even trying!

Once the pollen fertilizes the egg in the flower ovary, the plant will go on to produce fruit and seeds. So we have pollinators to thank for all our fruits and nuts, and lots of our vegetables too!

*Write the following list on the board:

Pollinator	Type of Flower Preferred
Beetle	white or dull-colored, fruity or spicy odor
Honeybee	showy, bright petals, often blue or yellow
Carrion Fly	smells of dead fish or meat
Mosquito	small flower, often white or green
Butterfly	red, orange, blue or yellow flower
Bat	large flower, with fruity odor and lots of nectar
Hummingbird	red flower, little or no odor
Moth	white or yellow flower with heavy fragrance
Wind[A]	small, odorless, colorless flowers

206

MORE

ANote: grasses, corn, etc., tend to be wind pollinated. Since they rely on the wind, they don't have to produce showy or scented flowers to attract pollinators.

*Divide the class in half. One group should be Pollinators, the other Flowers.

*Assign each member of the Flower group to a flower "type."

*Have them write on construction paper a short description of what type of flower they are (i.e.: Bright red, no scent; or white, very sweet-smelling, etc.). Pin the description to their shirt.

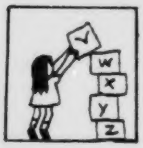
*Now take the pollinator group aside and whisper to each pollinator their new identity (honeybee, wind, bat, etc.).

*Then have the two groups mingle silently until each pollinator has found his or her "right" flower. (They will undoubtedly have to refer to the chart on the board). Remind the class that there can be more than one pollinator to a flower--some pollinators will like the same flower.

*Since the Pollinators have no identifying tags, have each Flower guess in turn the identity of their pollinator ("I'm a bright red flower, so you're probably a hummingbird!)

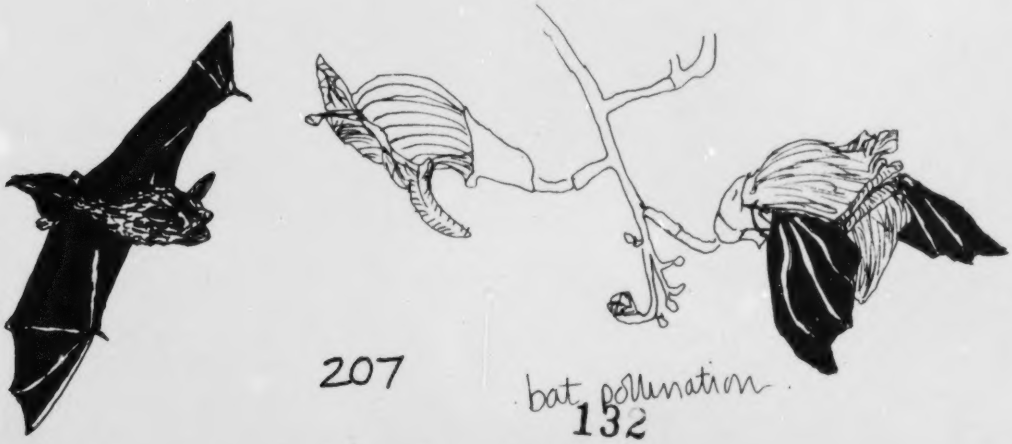
Most scientists believe that flowers and their pollinators coevolved. That means that they changed over time to suit each other; they adapted to each other. How does this coevolution benefit the flower? the pollinator?

During the game you probably noticed that often several pollinators like the same flower. For example, often bees and butterflies visit the same type of flower. How would that be an "advantage" for the flower?



*Now go outdoors and have the Pollinators find a real flower they like! Then ask the Flowers to look around the garden for their real pollinators. Can they find any bees, hummingbirds, beetles, or wind?

*Go outdoors with students and sit quietly near some flowers. Watch carefully. What pollinators do they observe? How long do they stay on each flower?



bat pollination

Magic Spots

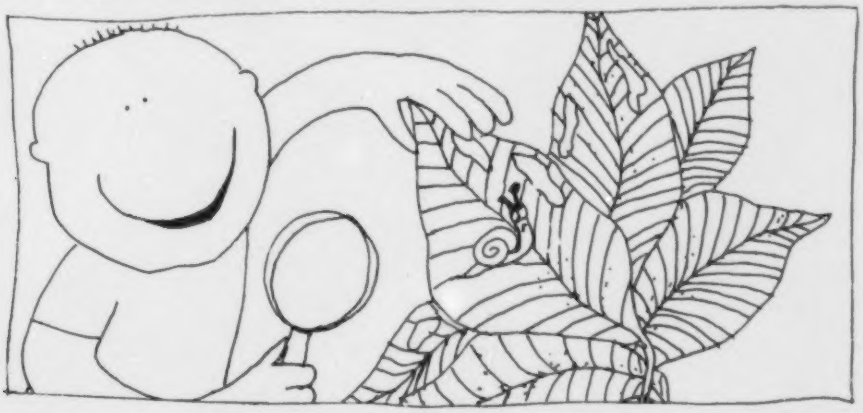
purpose

To demonstrate the variety of living organisms and their interrelationships in a little disturbed environment.

Materials: Garden or natural environment; drawing boards; journals; pencils; insect reference books (optional).

ACTION

Choosing one location in the garden to observe for 3-4 weeks, students will record the habits of insects and changes that occur in this habitat. A habitat is the environment of a living organism necessary for it to survive. Insects and plants in the habitat will provide shelter and food for each other. To observe a habitat students should get as close to the area as possible, be very still and quiet, and disturb the area as little as possible.



*Have each student choose his/her own magic spot in the garden or a natural environment. Their spot should only consist of one or two mature plants. Avoid "visiting" insects (flying insects which visit each plant briefly).

*Have students observe in their special spots until they discover at least three different types of insects. They can carefully look under leaves, inside the plant, and in the soil around the plant.

*Have students draw their special habitat including the plant and the insects' locations in relation to the plant.

*Have students describe the insects in their journals: what does it look like? (winged, legs, mouth); where does it live? (under the leaf, in the ground); what does it eat (the plant,

MORE

aphids, flying insects).

*Repeat this activity at least once a week for 3-4 weeks. Have students record the changes they observe in their habitat. Have students share observations.

Which habitats had the largest variety of insects? What kinds of insects were found in more than one habitat? What does the plant provide for the insects living around it? What do the insects provide for the plant? How could you control insects eating your plant without destroying other insects in your habitat? Categorize insects and plants in your habitat as helpful or harmful to your plants. Explain your reasons for putting the insects in the different categories.

*Use insect guides to research the name and habits of the insects in the habitat.

*Collect a sample of each insect to mount. Label it with what it eats, where it lives, and its relationship to humans.

The Garden Puzzle

purpose

To demonstrate the principles of companion planting.

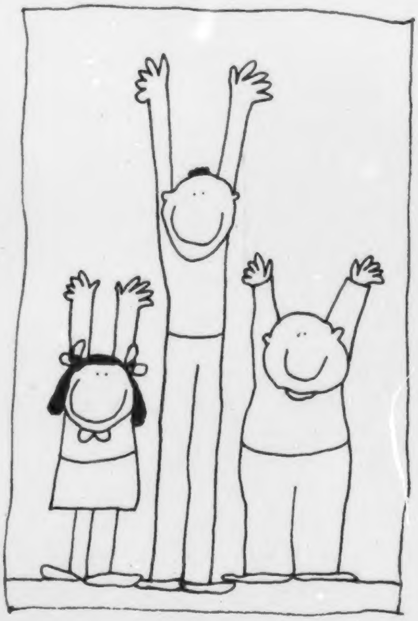
Materials: Pictures of common garden plants.

ACTION Students will roleplay plants in a garden to show how different plants have different space requirements; how different shaped plants can be grown together to use root and canopy shapes efficiently; and how efficient use of garden space will leave little room for weeds.

*Create boundaries for an imaginary garden large enough for 3/4 of the class.

*Act I. Scene 1. Create a small corn field. Have half of the students be corn plants standing with their hands above their heads to represent tall slender plants. Have these "corn stalks" step into the garden and space themselves so with their hands outstretched horizontally, their fingertips just touch. This represents a common corn monocropping system.

*Scene 2. Now we need some weeds. Weeds are persistent, unwanted plants that take advantage of any space left by the corn plants. They can be tall and thin, like the many varieties of wild grasses. Or they can be short and squat or even prostrate, like field bindweed or pigweed. Choose some students to be tall ones; they will look similar to the corn plants, with their hands up, over their heads. Other weeds can be represented by students stooping over. Others will crawl and grab the legs of any other plant in the garden. Gradually the "weed people" enter the garden until all the available room is gone. Those crawling weeds can be really disruptive and may even pull other plants down (slowly!). Ask the "corn people" how they feel competing for their space.



MORE

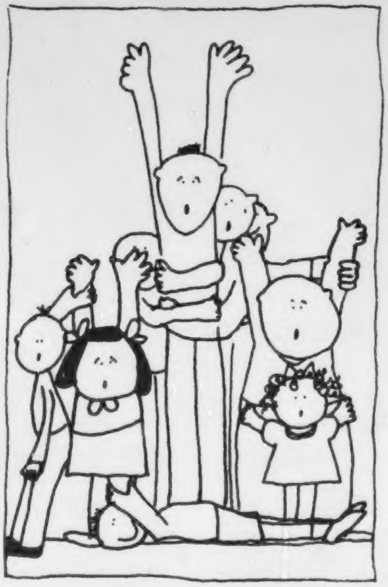
It should be getting uncomfortable.

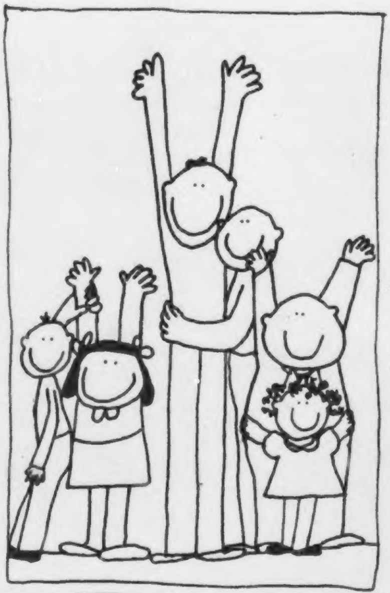
*Act II. Scene 1. In Act II we will plant other kinds of plants between the corn plants. A new corn crop should assemble as before in the garden. Now, to keep those pesty weeds out maybe we could find some plants that eliminate the extra spaces in between the corn. Hmmm...should we use tomatoes? Well they might fit, but, I heard those corns talking about tomatoes and they don't seem to like being very close to them. They take up too much of their root space and also seem to make corns a little sick. Well, we'd better see if we can find a plant that gets along better with the corn (refer to Companion Planting Guide, p. 38-39). American Indians used to plant pole beans alongside with the corn. The pole beans used the corn stalk for support. The beans didn't strangle the corn and they actually brought nitrogen from the air into the ground to help feed the corn plants. Well corns, what do you think? Should we let these beans lean on you for a little support if they come through with the snacks? The "bean people" enter the garden. Only one bean plant to one corn plant, please!

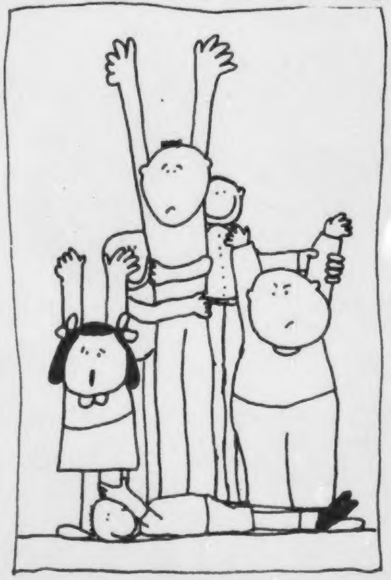
*Scene 2. Now we still have a problem. It looks like there is still room for the weeds. (Enter weeds again.)

*Act III. Scene 1. We'll have to find another companion for the corn and bean dynamic duos. Let's find a plant that is low to the ground, doesn't need too much light and one that won't put down deep roots, like the corn and beans. We've got to fill in pretty irregular spaces... What about squash? They have broad leaves, don't need too much light and the Indians planted squash along with corn and beans too. Have students emulate squash plants by squatting down on their haunches. Fill in the empty spaces in the garden.

Scene 2. Okay weeds, ready for the last try? All right, but where will you go? There is no extra space in that garden,



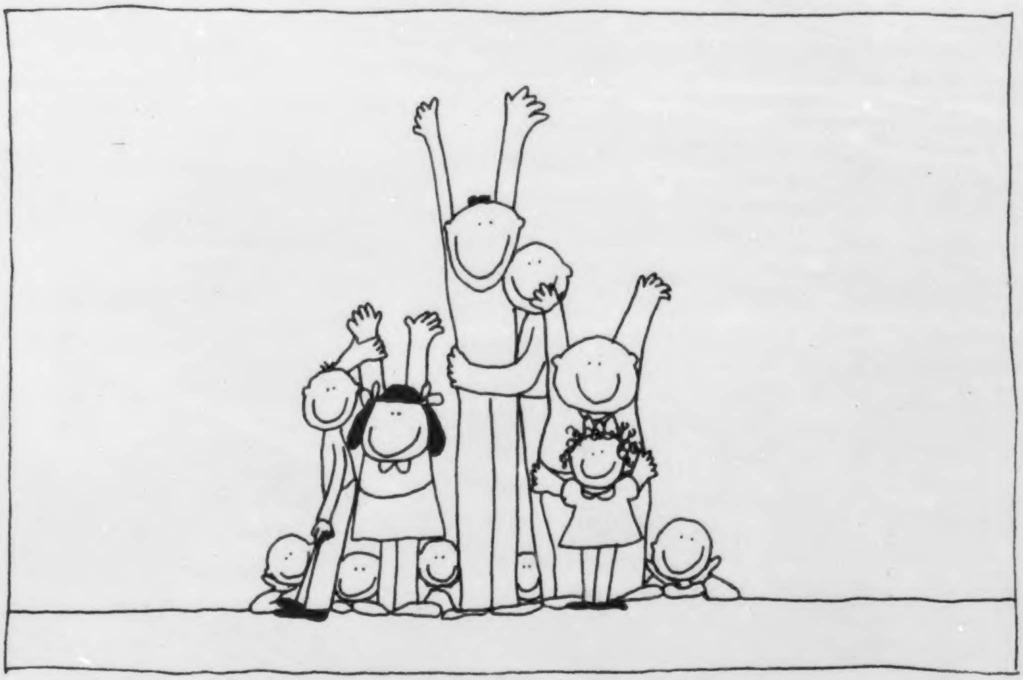




and its sure hard for weeds to grow above the squash to get sunlight. Even a tenacious bindweed would have trouble finding a home in there.

*And thus, the principles of companion planting are revealed. The garden has become a place where three crops can live together comfortably, support one another, and, even help each other to eat.

How can companion planting prevent weed growth? What are three things to consider when choosing companion plants? Why can weeds grow easily in a field of corn?



Plant Architects

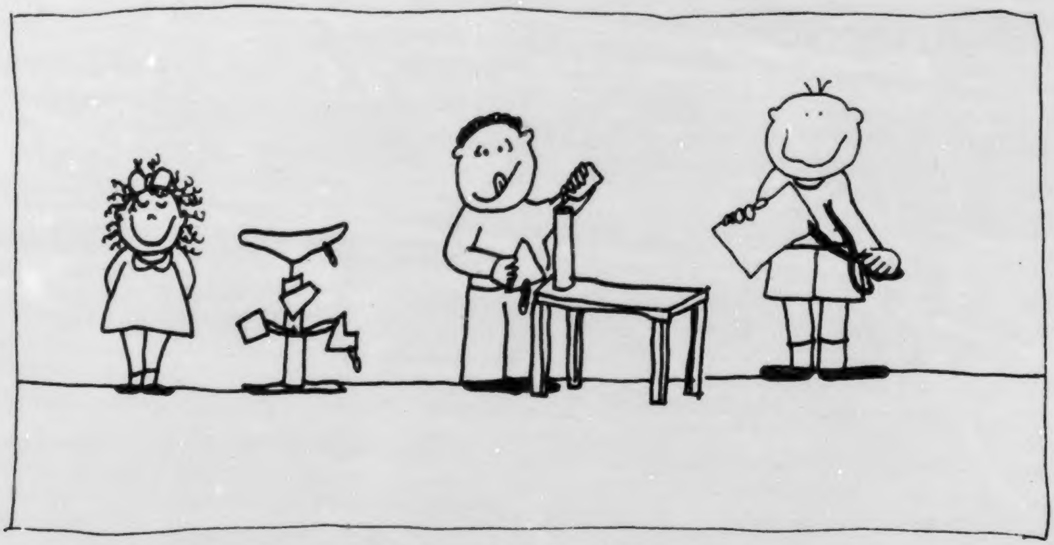
purpose

To illustrate how the shape of some plants can affect the growth of other plants, especially weeds.

Materials: Construction paper, scissors, glue, cardboard tubes, coat hangers, and/or sticks (for stems), planter box or bed.

ACTION

Students will create their own crop plant then place it in the garden to determine the effect of its shape on weed growth. One way that plants protect their food is by their shape. Some, like squash, might grow big broad leaves that make so much shade that weeds don't get enough sun to grow. Another plant, like parsley, might be short and skinny, but it grows so fast and close together that it leaves no room for weeds. What we want to find out is how the shape of a plant can affect the growth of weeds in the area around it.



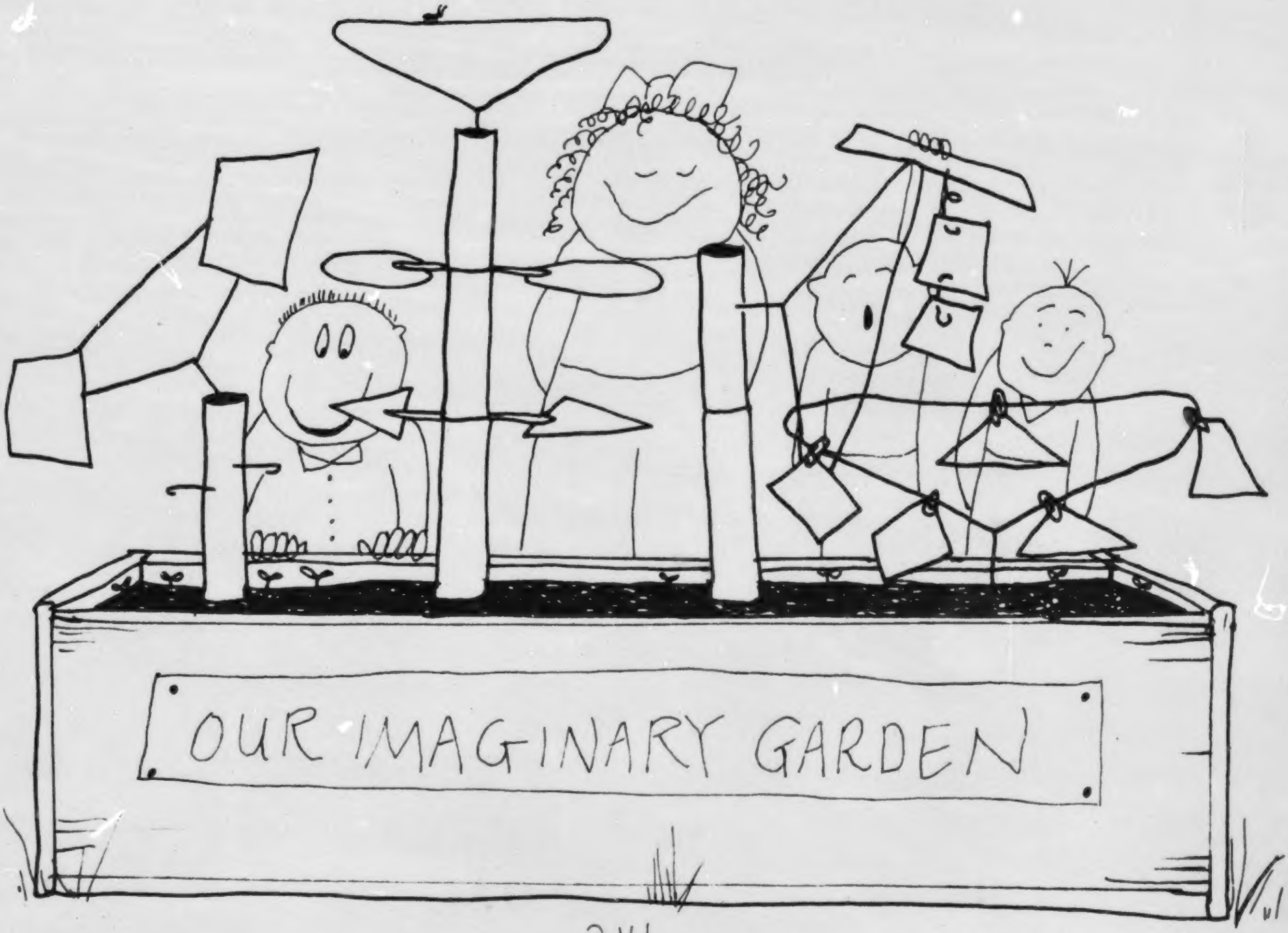
*Have each student design and construct an imaginary crop plant. Encourage a variety of designs--tall skinny ones, short fat ones, etc. They need not be models of real plants, and the students can make up their own names for them. In their design, have them consider: how the plant will get light, and how the shape will protect the plant.

*Next have the students prepare a bed of soil in a planter box or a small bed outside, but without planting any crops.

*Have each student plant their imaginary plants in 3/4 of the prepared soil. Leave one area "unplanted" as a control to see the number of weeds that will grow without the plants. Make sure there are no weeds already growing in either area. Leave the imaginary garden for two weeks, then return and have the students count the number of weed plants in the area immediately surrounding their own imaginary plant.

*Have the students replant their imaginary plants in a pattern they think would be the best way to keep weeds from growing.

Did some plants have more weeds than others? Did some have none at all? What was the shape of the plants that had the fewest weeds around them? What prevented the weeds from growing?



I Need My Space

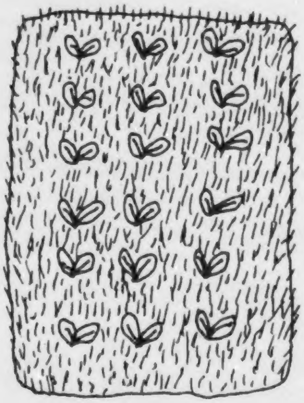
purpose

To explore the effect that spacing has on controlling weed growth.

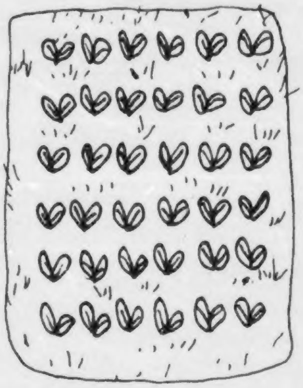
Materials: Radish seeds, three small plots (2' x 2') in a garden.

ACTION

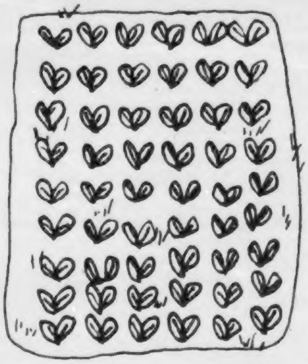
Students will plant three experimental plots with the same seeds at varied spacing to discover a way to keep weeds from growing big and strong. All plants need light. Without light, a plant cannot grow strong and tall. It would just be weak and withered. We will find out if we can plant the radish seeds so that they have enough room and light, but the weeds will be shaded and will not grow.



PLOT 1



PLOT 2



PLOT 3

*In plot #1, plant the radish seeds six inches apart with rows six inches apart also.

*In plot #2 plant the seeds three inches apart with rows 3 inches apart.

*In plot #3 plant the seeds one inch apart with rows one inch apart.

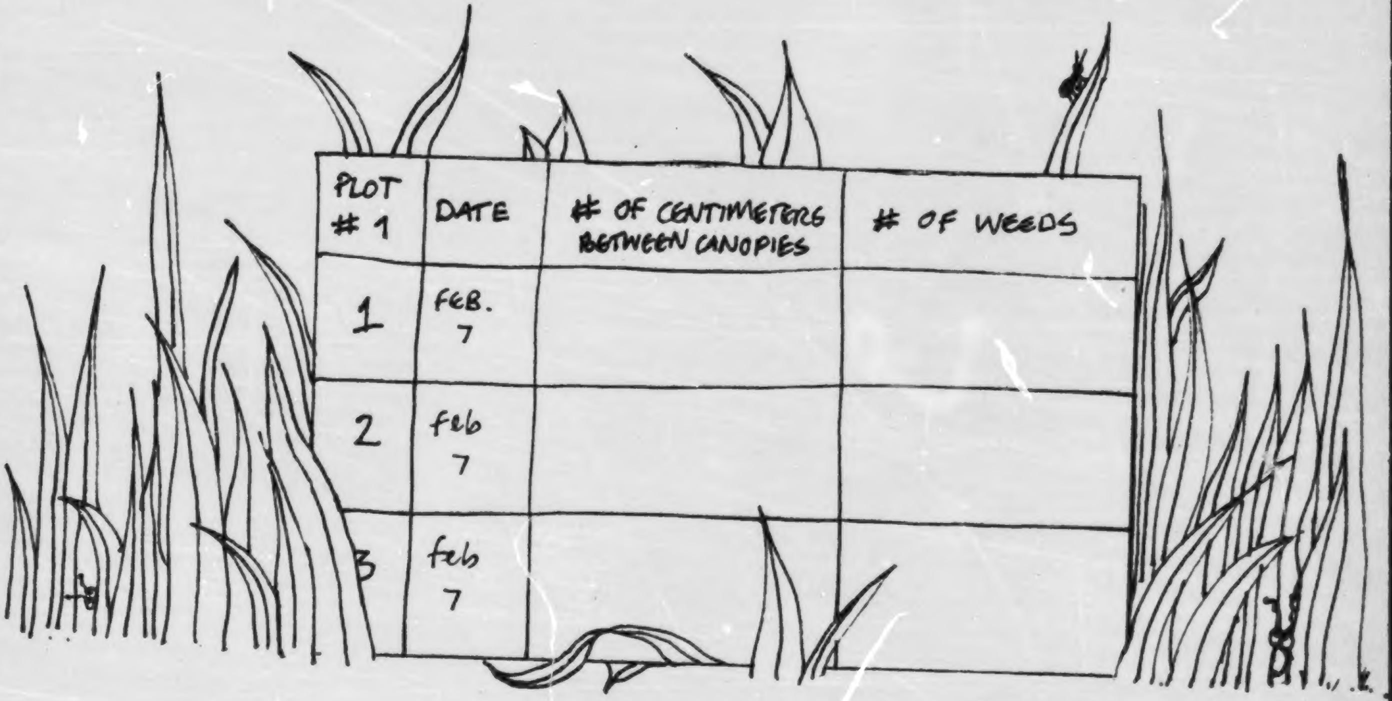
*Water each plot exactly the same.

*Weed the plots completely at 10 days.

*Then wait two weeks and count the number of weeds in each plot. Keep a count of the number of weeds over one inch tall in each plot. Also keep records of the space between the canopy of the plants until the radishes are ready to harvest.

*Analyzing the results: This demonstrates the principle of interference. All garden systems are designed to eliminate too much extra space for unwanted plants or weeds. The experiment has the radish planted so close together that when they get larger, or more mature, they will be crowded. To continue the experiment and to determine the optimum spacing for mature plants, thin the radish so the leaves just touch until the plants reach maturity.

Which plots have less weeds? Why? Name one reason it is good to plant close together. Name one reason it is bad. How can you find the best distance to have between plants?



PLOT # 1	DATE	# OF CENTIMETERS BETWEEN CANOPIES	# OF WEEDS
1	FEB. 7		
2	feb 7		
3	feb 7		

POISON DARTS

purpose

To illustrate how a plant can emit natural poisons that prevent other plants from growing.

Materials: One gallon plant containers (4 for each group); containers for water or slurry (4 for each group); garden soil; masking tape; marker; journals; leaves from some of the following plants: eucalyptus, bay, pine, tomato, sagebrush, tobacco.

ACTION

Read the following to students as an introduction: Have you ever noticed how animals sometimes protect their food--like a dog that growls when a cat comes near at dinner time? But what do you suppose a plant might do if it wants to protect its food--the soil, sun, air, and water it needs to survive? Since they can't growl or chase or bite, some plants have discovered their own ways to scare off other plants that want their food. Sometimes a weed can do this by preventing our crops from growing next to it. But other times, a crop plant is the one that gives off the poison so weeds can't grow underneath it. In this lesson, we're going to see if we can find plants that protect their food by keeping weeds from growing near them by producing their own weed poison.

*Divide students into experiment groups of 5. Give each group four one-gallon containers.

*Have each group fill their containers with regular garden topsoil dug from the same area.

*Have each group prepare three types of slurry. Finely crush leaves of one of the following types of plants: eucalyptus, bay, pine, tomato, sagebrush, tobacco. Dissolve the leaves in water so the mixture can be poured through soil. Label each container of slurry.

HERE LIES WEEDS ~
thanks to
EUCALYPTUS SLURRY

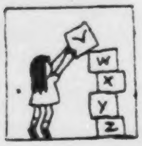
*Label one soil container "water." Label the remaining soil containers with a type of slurry.

*For one week, 'water' each soil container with the appropriate slurry. The one labeled "water" will serve as a control so 'water' it with water.

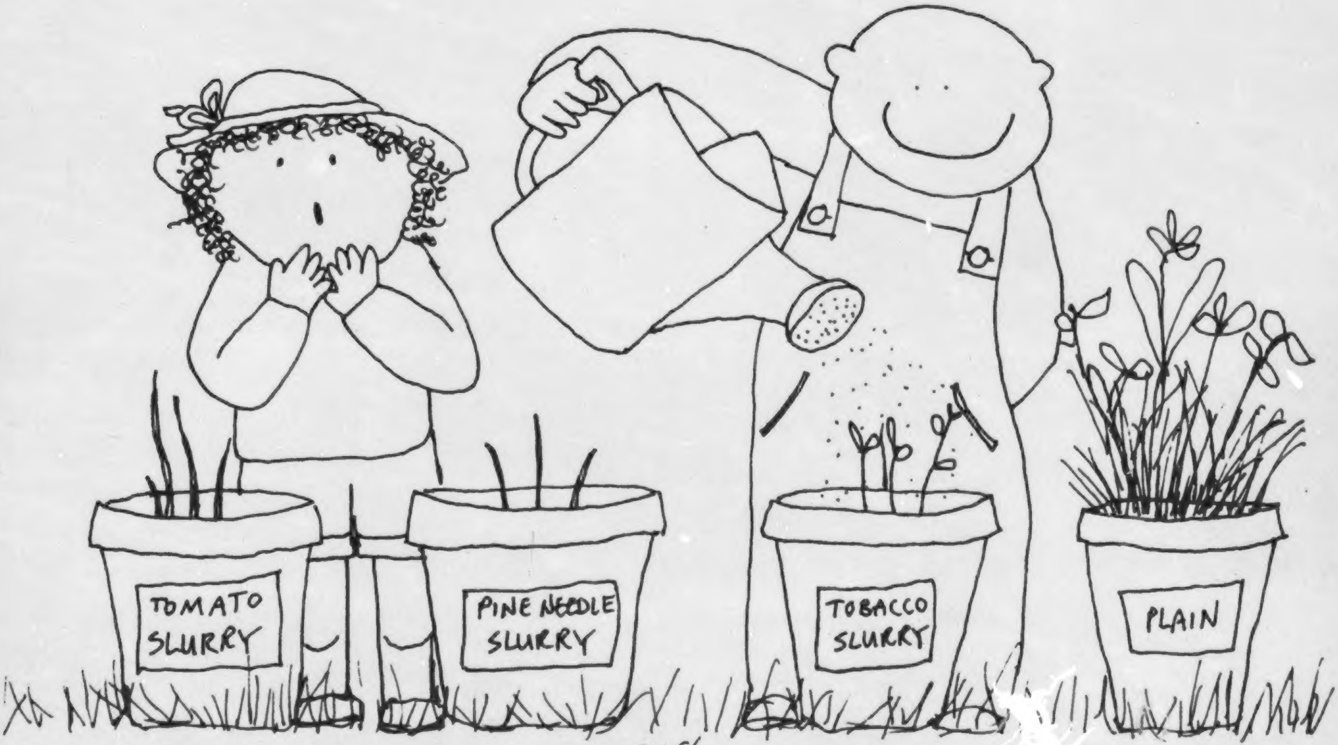
*After one week, count the number of weeds which germinated in each container. Record the results. Continue observing and 'watering' for three weeks.

*Did any group have a container where no weeds sprouted? If so, it shows that the plant that was crushed may have some chemical in it that acts like a poison to weeds. Have the students look around the rest of the school grounds to see if they can find any plants that have nothing growing beneath them.

Which slurry allows no weed growth? Why? Why is this an important adaptation for some plants? How can this help us in the garden?



Try spraying the slurry with no weed growth on weeds in the garden. Record the results.



Earth, Planet of The Insects

purpose

To explore the many ways that insects affect all life on earth.

Materials: journals

There are more insects than any other creature on earth. They have been around for at least 400 million years, whereas people have been on earth only about 100 thousand years. And we are still discovering new kinds of insects!

*Go into the garden. Sit quietly for several minutes in a few different spots in the garden, and watch. What kinds of insects do you see? What are they doing? Are they eating? Being eaten? Now go around and look under rocks or logs. What insects do you see there? What are they doing?

*Once back in your classroom, ask students to help make a list of the ways insects harm us and help us. Write it on the blackboard. Examples might be:

Ways Insects Harm Us

- Eat our crops (caterpillars, beetles)
- Eat wood (termites)
- Eat clothes (clothes moths)
- Sting, and suck blood (wasps, mosquitoes)
- Transmit diseases (some ticks transmit Rocky Mountain Spotted fever)

Ways Insects Help Us

- Many are pollinators (bees, butterflies)
- Bees produce honey; silkworms make silk
- Some are predators and parasites of insects that harm us
- Many are beautiful
- They are the food source for many animals (birds, frogs)

*Now ask students to pretend that starting tomorrow, there would be no more insects. Ask them to write about what life would be like without insects. How would things change?

MORE

Possible answers are:

1) There wouldn't be as many fruits and vegetables. Bees, for example, are needed to pollinate apples, cherries, and cucumbers, to name a few. Without pollinators, there would be few of these fruits.

2) Many animals would die. Animals such as frogs, birds, and ant-eaters depend on insects for food.

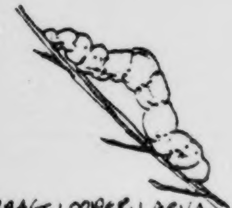
3) No honey or silk.

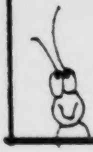
4) No butterfly wings, cricket calls, lights from fireflies.

5) No mosquito bites!

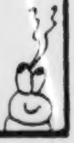
And much much more. Insects are really very important to life on earth!

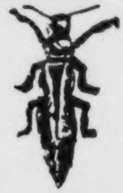
220

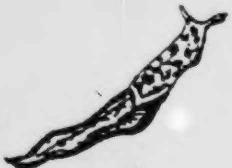

CABBAGE LOOPER LARVA

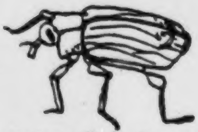


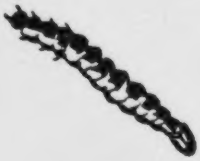
COMMON PESTS

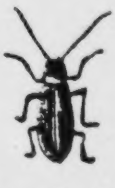


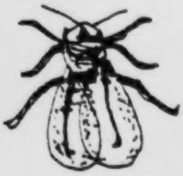

ADULT THRIPS

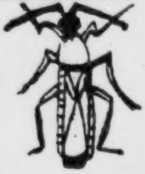

SLUG

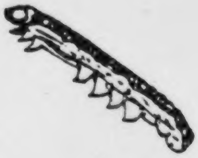

ADULT VEGETABLE WEEVIL

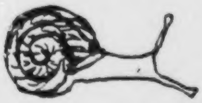

WIREWORM LARVA

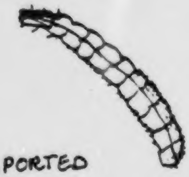

ADULT WIREWORM

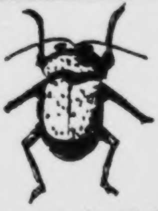

ADULT WHITEFLY

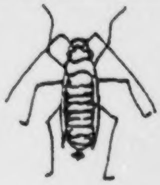

ADULT SQUASH BUG

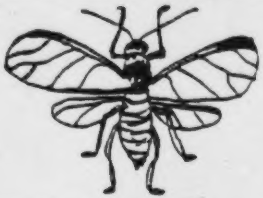

TOMATO FRUITWORM LARVA

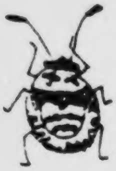

SNAIL

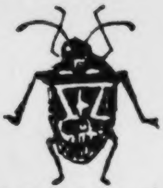

IMPORTED CABBAGE WORM LARVA

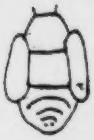

ADULT FLEA BEETLE

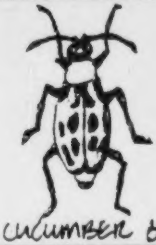

~~WINGLESS~~ WINGLESS APHID

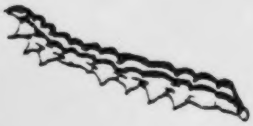

WINGED APHID

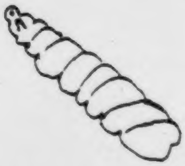

HARLEQUIN BUG NYMPH

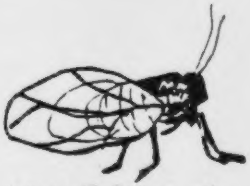

ADULT HARLEQUIN BUG

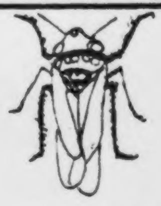

PSYLLID NYMPH

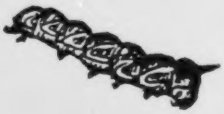

ADULT CUCUMBER BEETLE

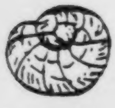

BEET ARMYWORM LARVA

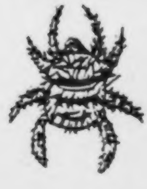

SEEDCORN MAGGOT LARVA

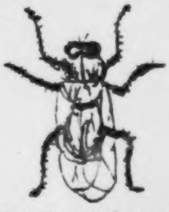

ADULT PSYLLID


ADULT LEAFHOPPER

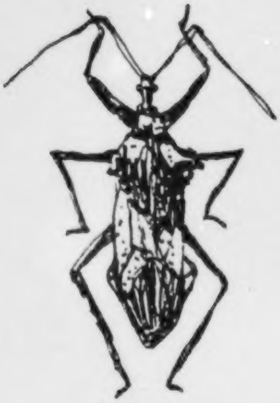

TOMATO HORNWORM LARVA


CUTWORM LARVA


SPIDER MITE

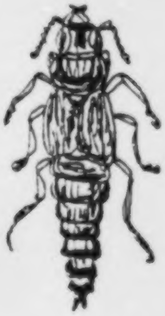

ADULT SEEDCORN MAGGOT

221

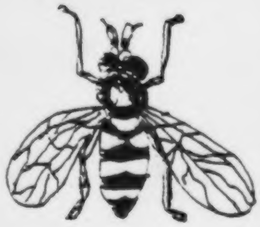


ASSASIN BUG

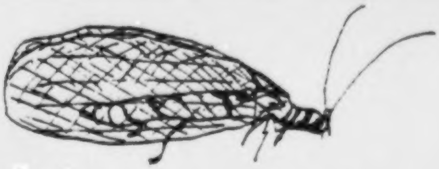
BENEFICIAL INSECTS



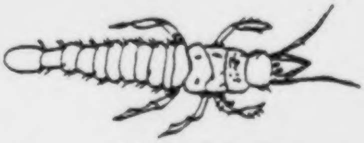
ROVE BEETLE



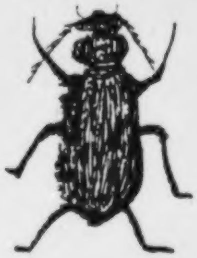
SYRPHID FLY



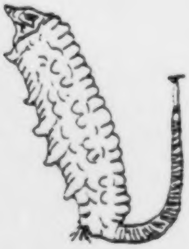
ADULT LACEWING



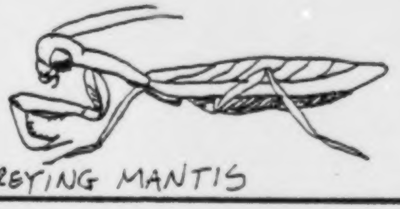
LACEWING LARVA



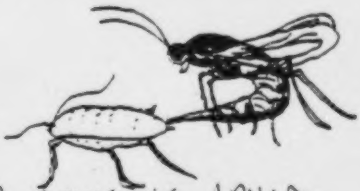
GROUND BEETLE



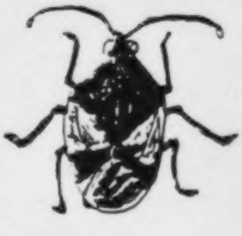
SYRPHID FLY LARVA



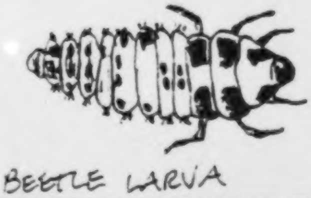
PREYING MANTIS



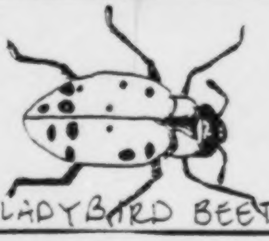
ADULT WASP STINGING APHID



ADULT MINUTE PIRATE BUG



LADYBIRD BEETLE LARVA



ADULT LADYBIRD BEETLE

Insect Anatomy or Make No Bones About It!

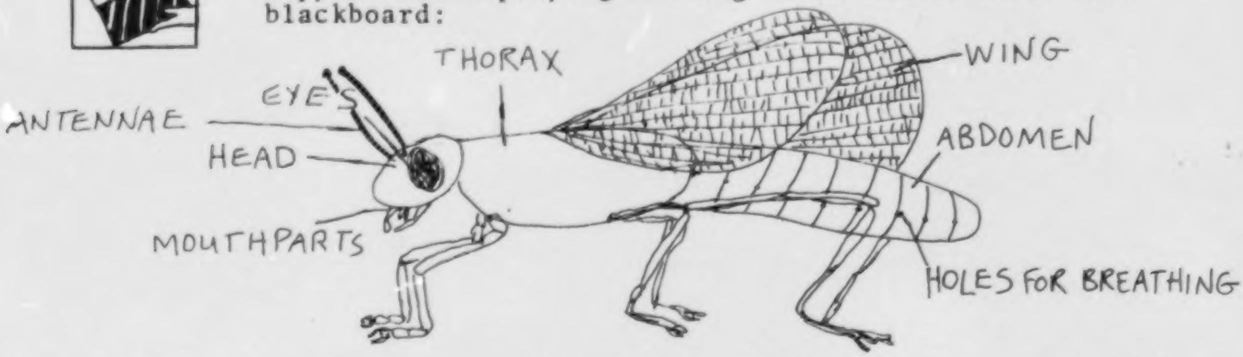
purpose

To identify the parts of insects.

Materials: journals

By drawing an insect and labeling basic parts, students learn the important features of insect anatomy.

*Copy the accompanying drawing of an insect onto the blackboard:



*Point out to students that virtually all insects share the following characteristics:

1) Six jointed legs (note that spiders, which have eight legs, are not insects!)
2) A body divided into three main parts: head, thorax and abdomen.
3) A pair of antennae.
4) Most have wings - usually two pairs.
5) A hard outer covering called an exoskeleton.

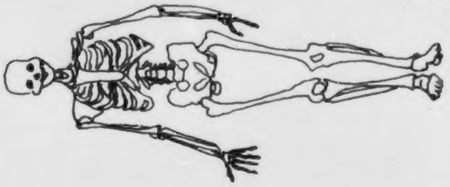
*Ask students to list as many different insects as they can (eg. mosquito, beetle, dragonfly). They look very different, don't they? Yet they are all called insects, and have body parts in common.

*Have students pick one of the insects from the list and draw it, labeling all parts. Make sure they include all parts listed above.

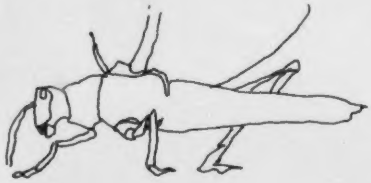
A moth and an ant have many characteristics in common. What are they?

One big difference between insects and animals is that insects have an exoskeleton, or a skeleton on the outside of their bodies. Ask your class to write about or discuss these questions:

Where is your skeleton?



HUMAN SKELETON

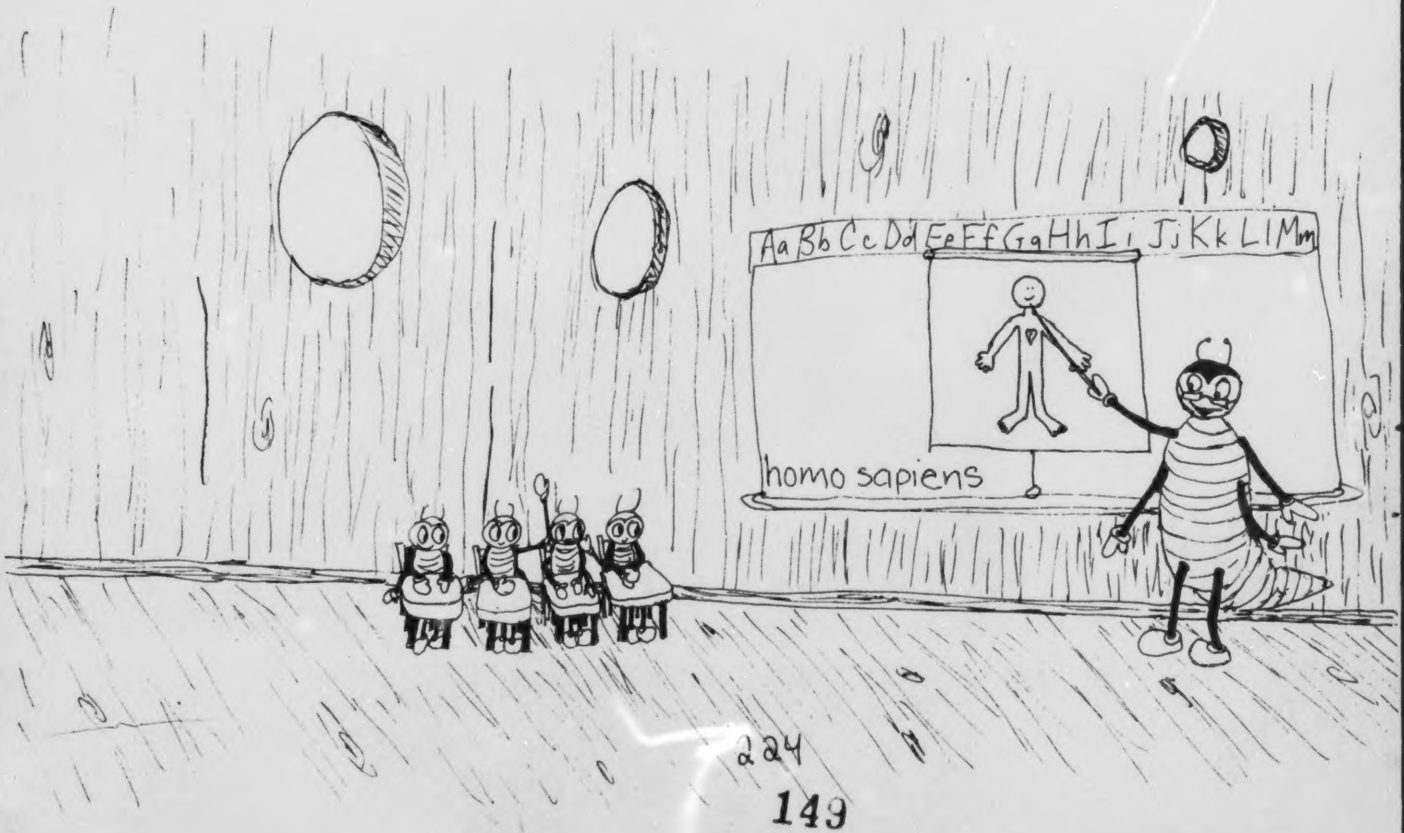


INSECT SKELETON

What does a skeleton do? (It supports the tissues and protects the internal organs).

What is the main advantage of a hard exoskeleton? (It is a "coat of armor" that protects the insect.)

Now that you know that insects have a hard outer covering, can you guess why they molt (crawl out of their exoskeleton)? (They molt because as the young insect grows, the exoskeleton gets too tight. They shed it and grow a new larger one.)


Aa Bb Cc Dd Ee Ff Gg Hh Ii Jj Kk Ll Mm
homo sapiens

BITECYCLE

purpose

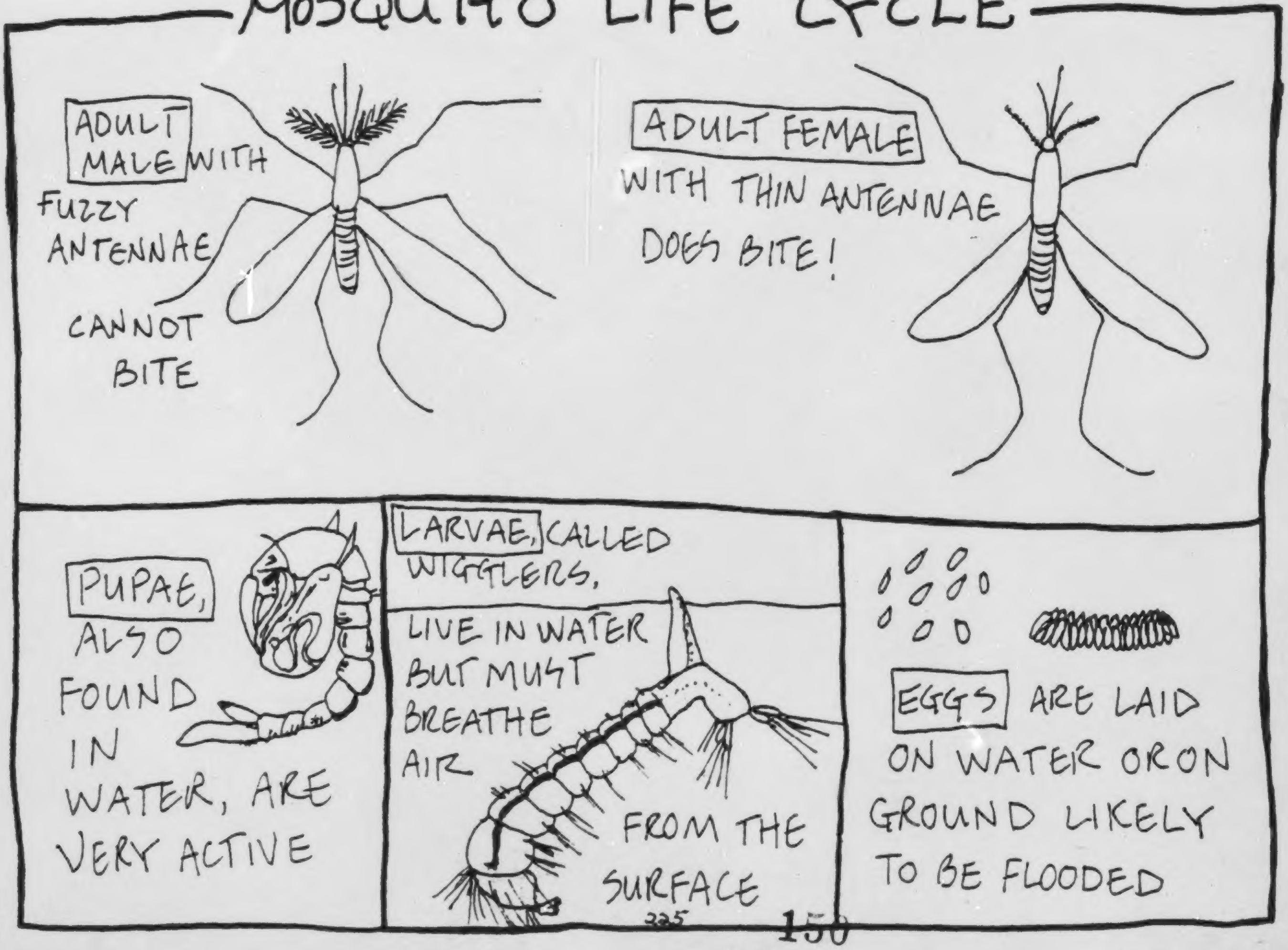
To observe the insect life cycle and the trophic levels of food chains.

Materials: 1 gallon jar or fish bowl; cloth cover and rubberband to fit over jar or bowl; pond water with mosquito larvae (wigglers); gambusia fish*, journals.

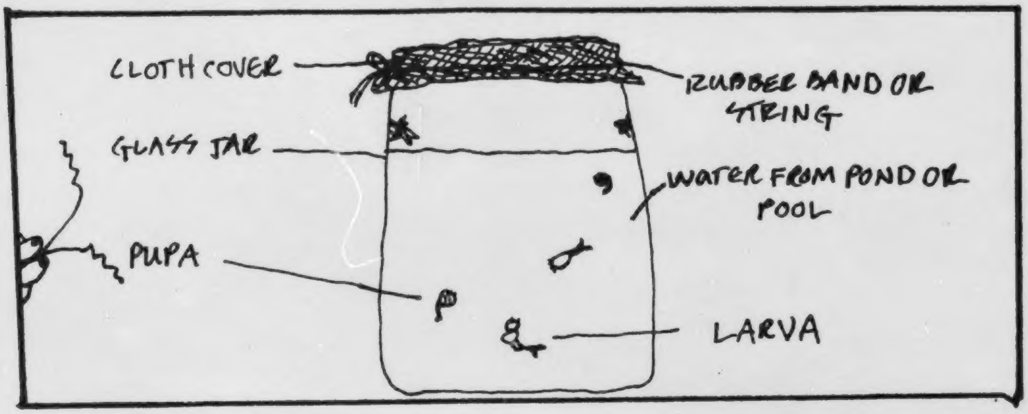
ACTION

This lesson will give students the opportunity to observe the metamorphosis of insects in their life cycle stages: egg, larva, pupa, adult. Mosquitoes are easy to rear. After students have observed all stages of the cycle, mosquito-eating fish (gambusia or minnows) can be introduced to reinforce the understanding of food chains and demonstrate trophic levels.

MOSQUITO LIFE CYCLE


ADULT MALE WITH FUZZY ANTENNAE
CANNOT BITE
ADULT FEMALE WITH THIN ANTENNAE
DOES BITE!
PUPAE, ALSO FOUND IN WATER, ARE VERY ACTIVE
LARVAE, CALLED WIGGLERS,
LIVE IN WATER BUT MUST BREATHE AIR
FROM THE SURFACE
EGGS ARE LAID ON WATER OR ON GROUND LIKELY TO BE FLOODED

*Fill a gallon jar half way with pond water that has mosquito larvae (wigglers). Secure a cloth over the top.



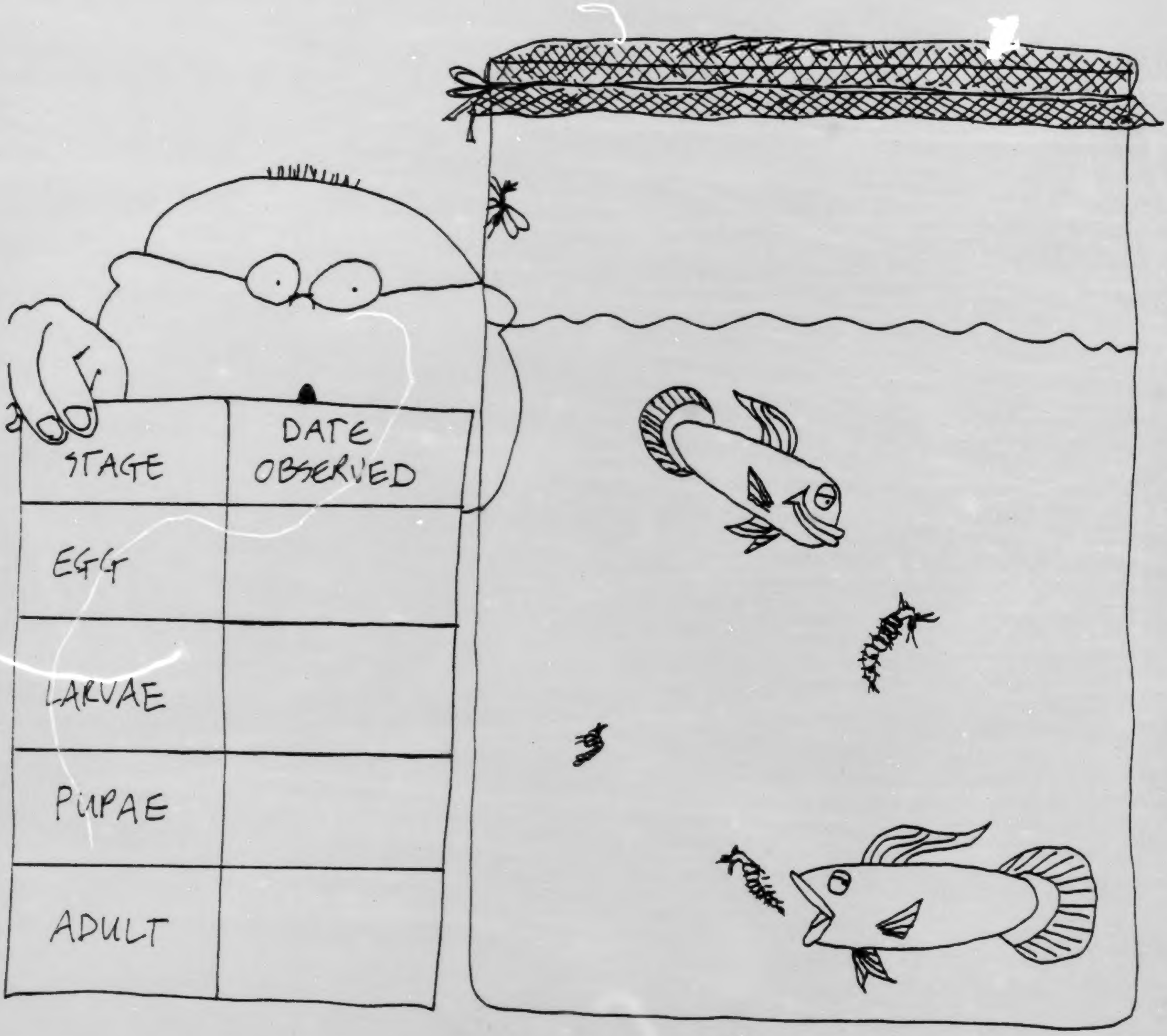
*Have the class observe the wigglers' development until they've seen all four stages of the cycle. (Note: the egg stage will not be observed until after the first batch of adults lays eggs.) Have a chart by the jar that allows students to record the date each stage is first observed.

*In their journals, students can draw the life cycles and record the number of mosquitoes.

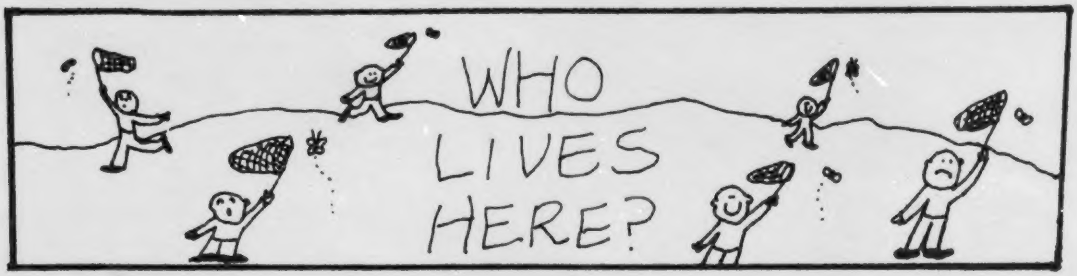
> Eggs: are laid on water or flooded ground. Most mosquitoes scatter their eggs, but some species lay eggs in small masses which float on the water.
>
> Larvae: live in the water. Their manner of swimming has given them the name "wigglers." Wigglers must breathe air. At one end of the body spiracles thrust up through the water's surface. Larvae feed on algae and organic debris. There is usually enough present in the water.
>
> Pupae: are quite active and different from most other insects. The comma-shaped pupa can be seen swimming to the surface of the water to breathe. In this stage, the air-breathing spiracles are on the thorax.
>
> Adults: emerge from the pupal skin at the surface of the water, and can light on the glass sides of the jar or even on the water. Only females can bite, and have relatively thin antennae. Males have bushy antennae.

*Introduce 2-3 guppies or gambusia (available from mosquito control centers). Have students observe the changes in the mosquito population. The mosquito population is controlled by introduction of their predator. Observe what stage of the life cycle the fish feed on. Pest management methods (both predator and spray-control) are often specific to particular stages of the life cycle. This example of the food chain also demonstrates trophic levels. Each higher level of the food chain must consume more energy (food) than the lower level. Thus the populations of each level decreases as you move up the food chain. Thus food chains are also called food pyramids.

What are the stages of the insect life cycle? How can we control the mosquito population? If we sprayed the mosquitoes with a poison, what else may be affected?



STAGE	DATE OBSERVED
EGG	
LARVAE	
PUPAE	
ADULT	



WHO LIVES HERE?

purpose

To introduce a method of insect collection and demonstrate the variety of insects in a habitat.

Materials: See net materials p. 230, for each small group have: jar with air holes, insect identification book, magnifying glasses, journals.

ACTION This lesson is divided in two sections. In Part I students will make insect collecting nets. This can be accomplished in small groups resulting in one net for each group of five students. Part II contains activities in collecting and identifying insects.

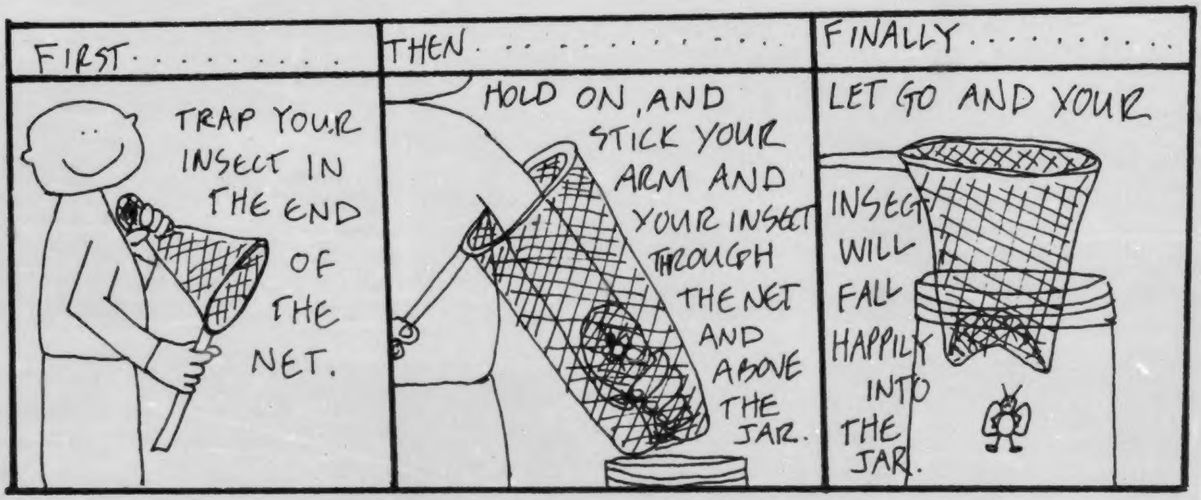
Part I

*Determine how many insect collecting nets you want to make. Divide your class into small groups and have each group make their own net. Have materials precut for each group. Follow directions on page 230. (Nets can be purchased from educational supply houses or outdoor equipment stores.)

Part II

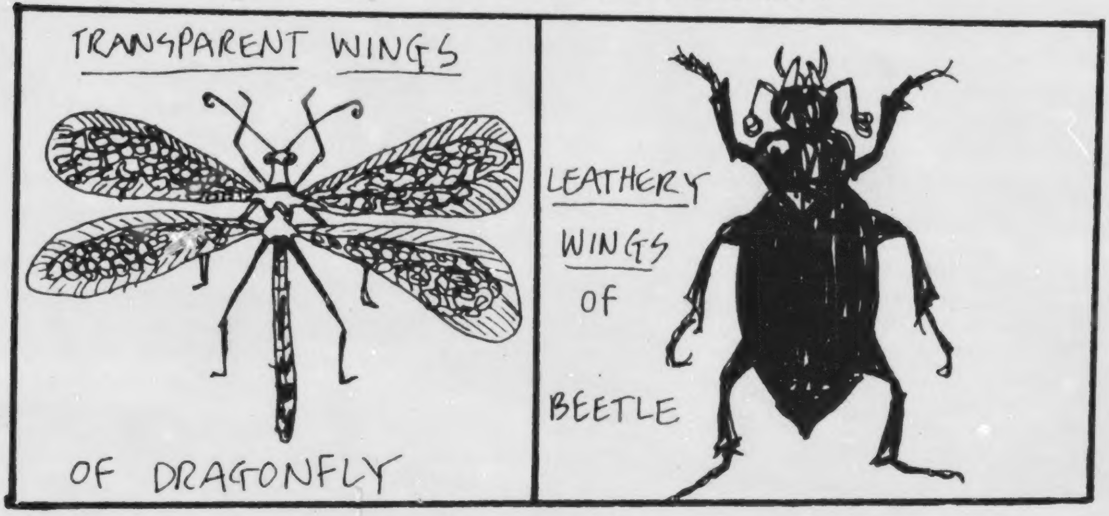
*Have each group choose a different habitat for collecting insects (garden, orchard, field, etc.).

*Students should spend approximately 20 minutes collecting. The net should be brushed through weeds, bushes, and branches of trees, sweeping insects off the plants. After a few sweeps, flip the end of the net over the rim to trap the insects. Flip the net again to force the insects to the bottom of the net and examine the catch.


FIRST.........
TRAP YOUR INSECT IN THE END OF THE NET.
THEN.............
HOLD ON, AND STICK YOUR ARM AND YOUR INSECT THROUGH THE NET AND ABOVE THE JAR.
FINALLY..........
LET GO AND YOUR INSECT WILL FALL HAPPILY INTO THE JAR.

*Trap the insects you wish to keep and transfer to the jar.

*Have each group record the habitat explored and describe the characteristics of each insect. Are the wings leathery or transparent? Does it have sucking or chewing mouthparts? Is the abdomen exposed or covered by the wings? Does it have two or four wings? Compare one insect to another.



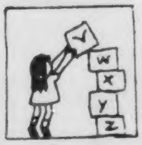
*Use the insect identification book to identify the insects.

*Determine each insect's food. What characteristics do insects with the same food have in common?

*Have each group share their discoveries with the whole class.

*Release the insects in their habitats. (Or you may want to mount samples of some of the insects. Directions for mounting insects can be found in insect books at the library.)

Do different insects live in different habitats? Do different insects live in the same habitat? What are some characteristics that insects share? How do they differ?



Have students choose one insect and write a story about it. Have them imagine why the insect developed its characteristics (wings, chewing mouth, color, etc.) to live in its environment.

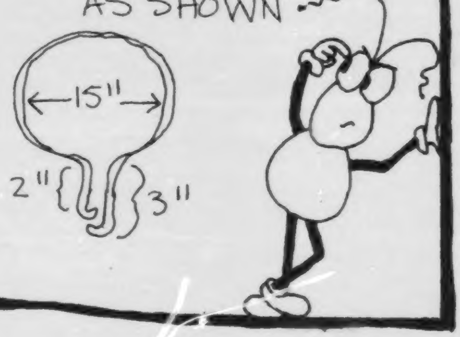
MORE

INSECT COLLECTING NET

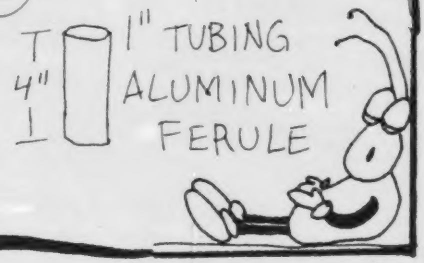
MATERIALS FOR 1 NET

- 1 52" PIECE #8 IRON WIRE
- 1 4" ALUMINUM TUBING
- 1 7/8" X 3' WOOD DOWEL
- 1 48" X 30" PIECE OF MUSLIN
- NEEDLE AND THREAD

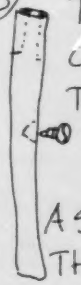
① TAKE WIRE AND FOLD AS SHOWN



②

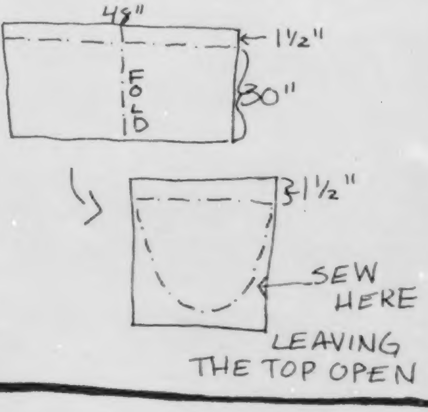

4"
1" TUBING ALUMINUM FERULE

③ TAKE DOWEL AND CUT 2 GROOVES TO HOLD THE WIRE

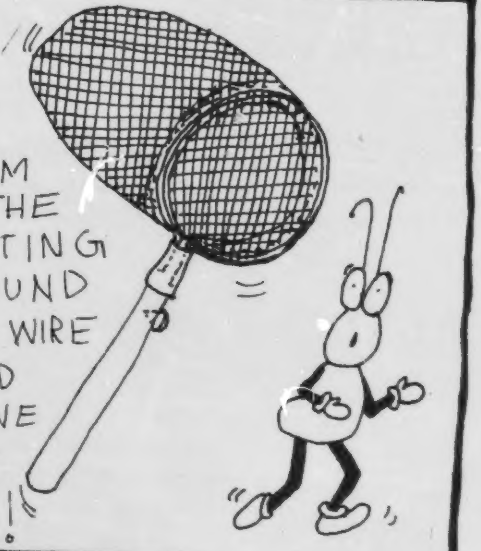


A SMALL SCREW KEEPS THE TUBING FROM SLIPPING

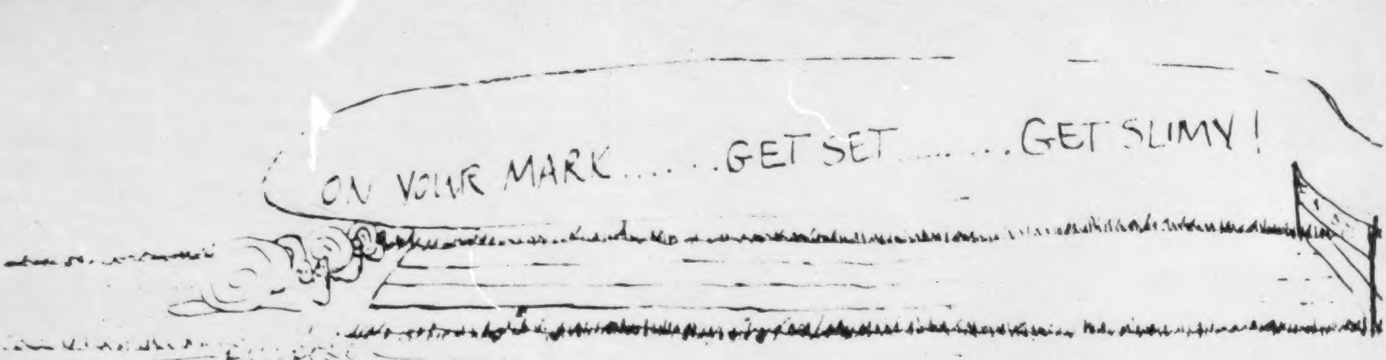
④ FOLD THE NETTING AND SEW AS SHOWN, LEAVING A 1½" HEM.


48"
1½"
FOLD
30"
1½"
SEW HERE
LEAVING THE TOP OPEN

⑤



HEM THE NETTING AROUND THE WIRE AND YOU'VE GOT IT!!



ON YOUR MARK.....GET SET......GET SLIMY!

Purpose

To identify pests and pest damage in the garden.

[illegible]

After determining the numbers and locations of a certain pest in the garden, students hold a "trial" to decide if the pest is in fact guilty of eating their plants.

The following can be read to students as an introduction.

We share our garden with lots of critters. Some we see and some we don't. They can live under the ground, on the ground, or in the air. Crawling, climbing, flying, jumping, slithering--they are always moving, probing, searching for food.

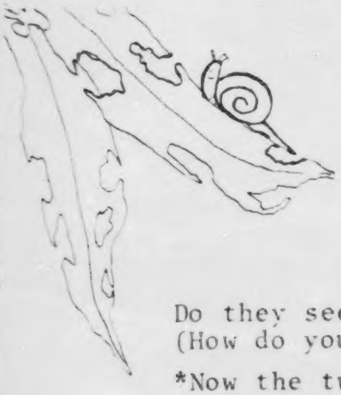
Who lives in our garden? Where do they go for food? Let's play detective and find out.

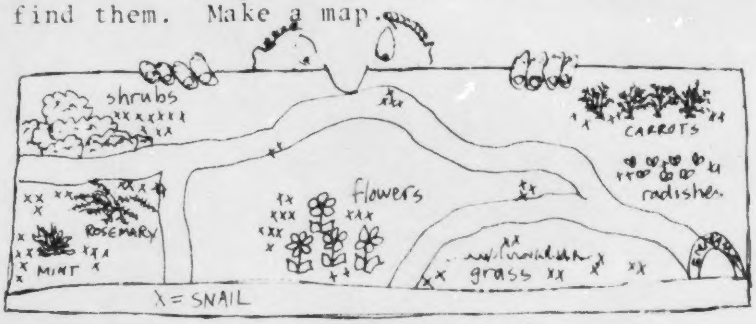
*Appoint a judge, a prosecutor against the snails, and a defense lawyer for the snails.

*Divide the rest of the class into two teams, one team to work with each attorney.

*Go into the garden (with pencil and paper) and find as many snails as you can. Look in overgrown places and on and around your crop plants, especially in between leaves where they like to hide. (Note: if there are no snails in your garden, pick another type of mollusk or insect that eats your plants).

*Count and record how many snails there are on any plant and shrub where you find them. Make a map.

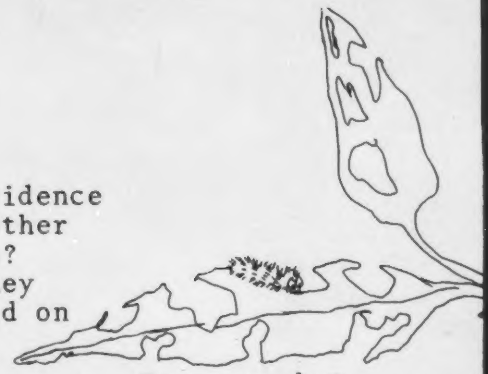




Do they seem to have a favorite hiding place? Or favorite food? (How do you know they were eating it? What signs can you find?)

*Now the two teams should divide up. The prosecutor's team should gather and record any evidence of snail damage such as damaged leaves, descriptions of slime trails leading to damaged plants, a count of the number of snails on plants nearby, etc.

MORE



*The defense attorney's team should gather evidence indicating that damage was caused by pests other than their clients, the snails. (Which ones? slugs? beetles? How can you prove it?) They should look to discover other pests that feed on leaves. Describe and map them.

*Now return to the classroom and hold a mock court. Everyone but the attorneys and judge sits as jury (remind the jurors to be impartial!) The prosecutor should present the evidence to convict the snails of plant-eating, and the defense attorney must try to prove their innocence, by presenting evidence that the damage could have been done by other insects. The defense attorney could suggest that the simple presence of the snails near the scene of the crime does not prove their guilt.

*Now let the jury decide! Remember, innocent until proven guilty!

If guilty, the judge must decide the sentence.

Is it always easy to tell what pest has been eating a plant? Why or why not?

Did your pest seem to have a favorite food in the garden? Would it die if you didn't grow that crop any more?

Are all insects pests?

Buggy Diner

MAKE MINE MILDEW
LOTS OF LETTUCE!
HOLD THE MAYO!

purpose

To demonstrate the feeding preferences of some common garden insects.

Materials: Ten plastic petri dish covers, garden insects, plant leaves, journals.

Preparation: The day before this experiment, collect ten garden insects and place in a jar with air holes. Do not feed.

ACTION

Did you ever wonder what insects eat? Not all insects eat the same foods. Some like to eat the leafy parts of vegetables and some like the roots. Some insects prefer other insects! In this experiment students will construct an insect diner and serve food samples to the invited insects.

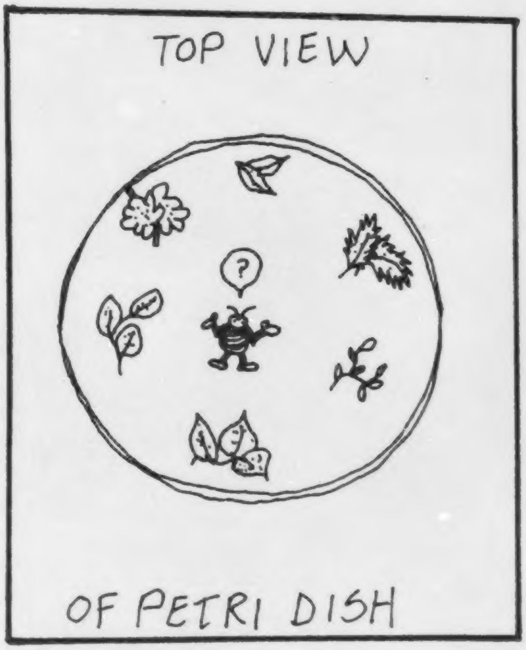
*Collect a variety of plant leaves from the garden. These will be food samples to determine the insects' preferences.

*Cut similar size discs from the plant leaves. It is important that they be the same size in order to get accurate results.

*Turn each of the petri dishes upside down. Place 6 leaf samples around the inside edge of each dish. Label the samples.

*The "diner" is now ready to open for lunch. Who will you invite? Choose one of the insects from the jar For example, you may invite a common and voracious eater, the spotted cucumber beetle named Spot. Place Spot in one of the petri dishes. Let Spot stay in the diner for 24 hours. Observe Spot every 2-3 hours to see what he is munching.

*Repeat the same experiment with other insects in the remaining

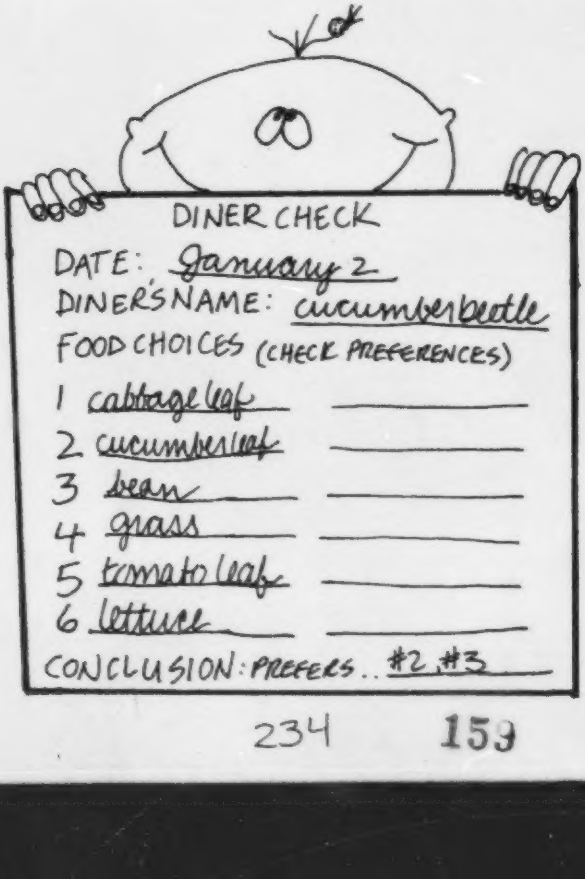


INSECT	FOODS THEY LIKE....
SPIDER MITES	BERRIES
APHIDS	CABBAGE, BEANS
CABBAGE LOOPERS	CABBAGE, LETTUCE
SNAILS AND SLUGS	LETTUCE, CABBAGE

petri dishes. To verify your results, introduce other insects of the same variety.

*Estimate the amount of each disc that was eaten. Record your results in your journal. You can use a chart similar to the one below. If Spot eats the same plant that we eat (like cabbage, lettuce, etc.) we wouldn't want him in the garden eating our food.

Which insects preferred to eat foods that we eat? Do we want them in the garden? How could you use a plant they did not like to go near to protect the food we eat? Which insects ate foods we do not want in the garden? How can we encourage them to stay in the garden?



DINER CHECK

DATE: January 2

DINER'S NAME: cucumber beetle

FOOD CHOICES (CHECK PREFERENCES)

1 cabbage leaf

2 cucumber leaf

3 bean

4 grass

5 tomato leaf

6 lettuce

CONCLUSION: PREFERS.. #2, #3

lady bug lady bug fly away home

purpose

To illustrate how a garden can become a home for beneficial insects.

Materials: Terrariums (or 1 gallon glass jars) with tight mesh covers; variety of crop and weed plants, soil mix, and ladybugs*.

Read the following to the students:
Sometimes it's good for gardens to have plants that you cannot eat. Even weeds can sometimes help certain crops. In this lesson we will examine one way that weeds in a garden can reduce crop damage from insect pests. Not all insects are pests in our gardens. For example, ladybugs help by eating insects that damage crops. They eat aphids that eat many vegetables, so we want to encourage ladybugs to live in our garden. One way we can convince ladybugs to do that is to make sure our garden has plenty of attractive ladybug homes and enough food. So in this lesson we're going to try to find out where ladybugs like to live.

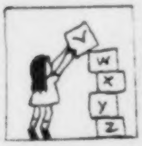
*Divide the class into groups of students and have each group create their own ladybug hotel in a large glass container. They can plant whatever they want, as long as they plant some crop plants and some weeds. Have each group plant different plant types. Transplant the seedlings into the terrarium with three inches of soil on the bottom. Let the plants grow for a few weeks.

*Ask the students to guess what plants the ladybugs will choose for their room in the ladybug hotel. Now get a

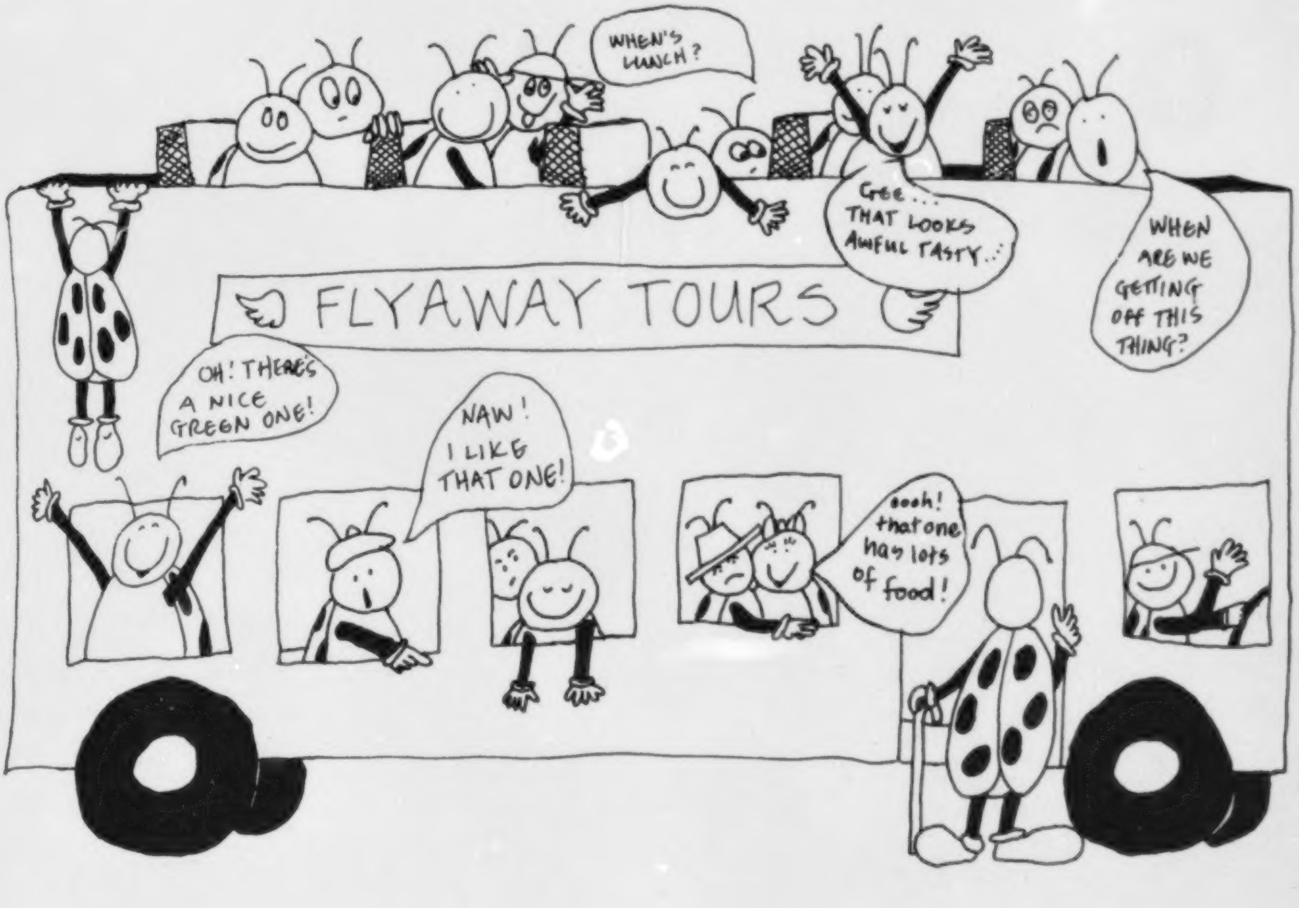
MORE

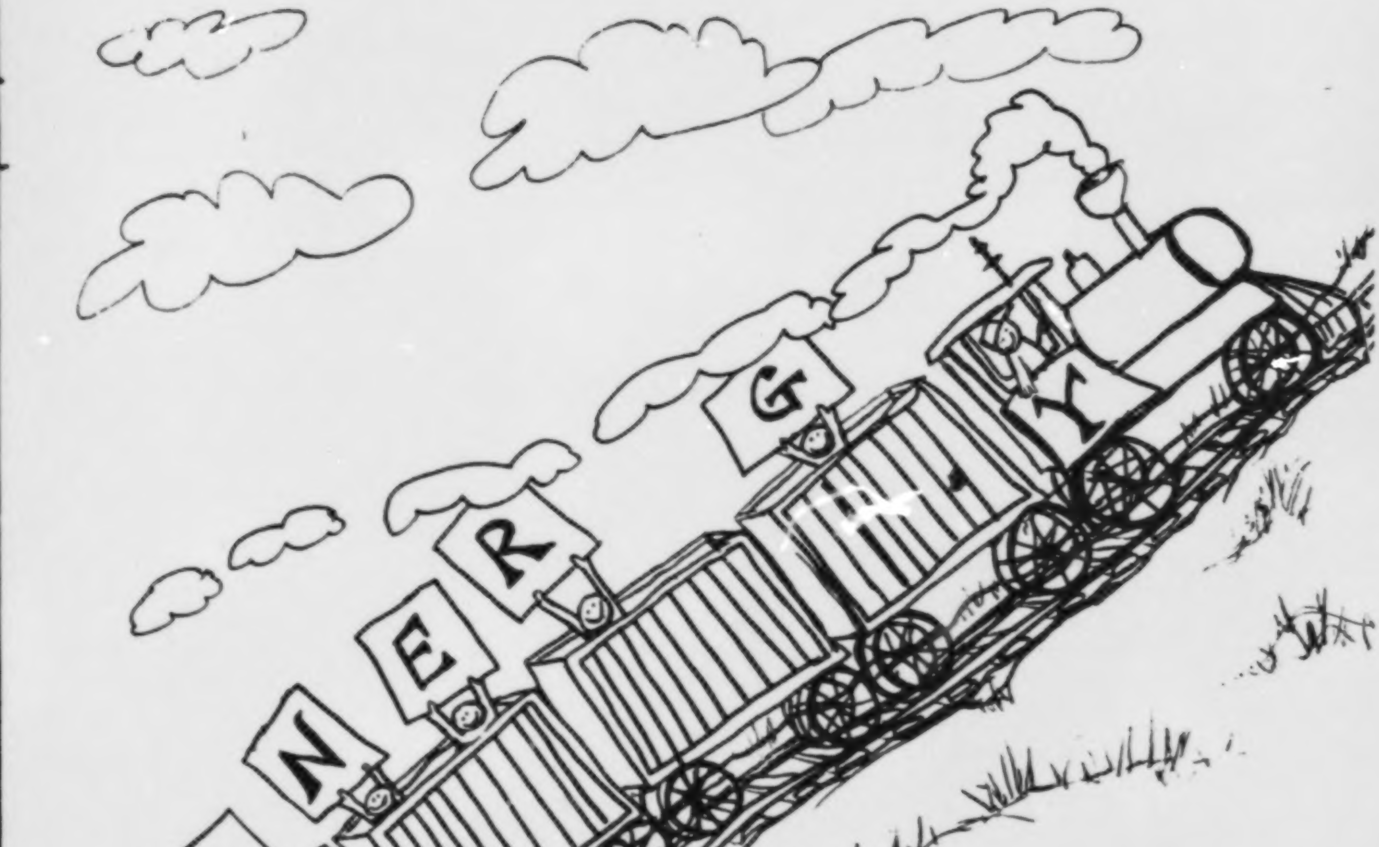
"busload of ladybug tourists" and release them in the terrariums. Also be sure to introduce some leaves with aphids for ladybug food. Return the next day and have the students write down which plants the ladybugs have made their homes in.

Do they seem to like some crops better than others? Why? Do they seem to like weeds even better than crops? Why? Is there a food source on the plants they made their home? If you want ladybugs to live in your garden to eat insect pests, which plants would you grow to attract them?



Go into the garden with journals and pencil and tally the number of ladybugs you find on different plants. Did specific plants have more ladybugs than others?


WHEN'S LUNCH?
GEE... THAT LOOKS AWFUL TASTY...
WHEN ARE WE GETTING OFF THIS THING?
FLYAWAY TOURS
OH! THERE'S A NICE GREEN ONE!
NAW! I LIKE THAT ONE!
oooh! that one has lots of food!



E
N
E
R
G
Y

Our individual and collective consumption of energy is explored in this unit with a look at some of the ways consumption patterns can be changed. The following unit, 'Recycling' should be done in conjunction with this unit.

Lesson Titles	Recommended Grade Levels
Energy Detectives	4-6
Are You A Loser, User, Or Saver Of Energy?	3-6
Big Mac Energy Attack	3-6
Eddie Electric And Motoring Mable	2-4
Pretzel Hog	4-6
Same-O, Same-O	4-6
Sin City	2-6
The Great Gearloose Creation	4-6

Special Materials & Where To Find

Big Mac Poster - Ask at your local MacDonald's or fast food chain.

*The above material is listed to assist you in locating it. All materials are listed with each lesson and most are readily available.

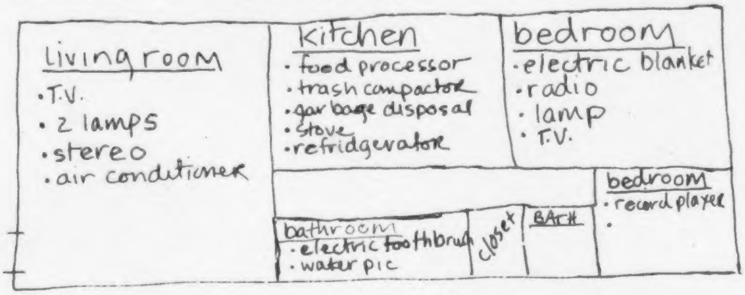
Energy Detectives

purpose

To examine the many ways we use energy in our lives.

*Ask students to list 10 ways in which they use, or benefit from the use of energy. Upon completion, ask them to individually rank order the uses from least important (#10) to most important (#1). Discuss. Then have your class attempt to come to a consensus on the three uses they would choose to retain if the rest were eliminated. This should be the source of a lively debate. Finally, try to agree on the one most important use.

*Design a home energy inventory. Ask each student to draw a rough representation of their home.


living room
·T.V.
·2 lamps
·stereo
·air conditioner
kitchen
·food processor
·trash compactor
·garbage disposal
·stove
·refridgerator
bedroom
·electric blanket
·radio
·lamp
·T.V.
bedroom
·record player
bathroom
·electric toothbrush
·water pic
closet
BATH

*As an overnight assignment, they should list their family's home consumers of energy. These should be listed by room. The next day discuss the uses and abuses of energy in their homes. Are all the energy-consuming gadgets necessary? Why do we use them? Which uses could be eliminated? reduced? What did people do 100 years ago? Did they have the same gadgets? How was their lifestyle different? What can we learn from them?

*Make a list of changes that can be made in our actions that would save energy. Try categorizing these changes in energy consumption by their impact on our behavior. For example:

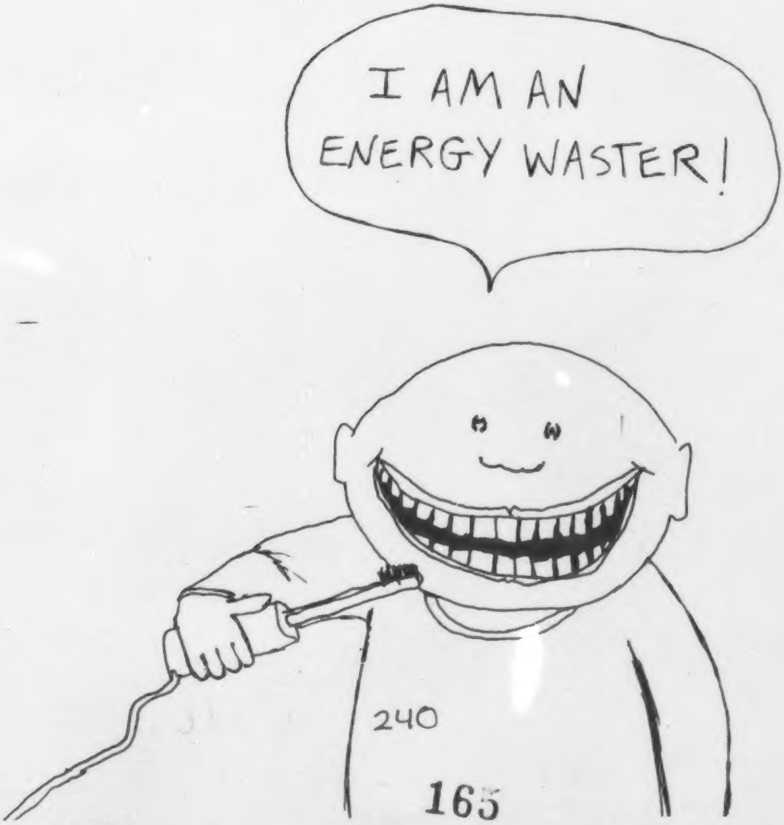
No Impact On My Behavior	Some Impact On My Behavior	Alot of Impact
Installing insulation	Knowing what we want from the refrigerator before we open it	Walking, instead of being driven

Design a home energy report card with your class in order to assess home use of energy. Attached is an energy report card prepared by a science class. Use any approach that you and your students feel is a valid test of energy consumption. Have the class take these home, and use for discussion the next day.

*Find out how three adults in your community feel about "the energy crisis".

*Project what your life would be like if electricity were eliminated permanently.

*Choose a current source of energy and write an obituary for it.


I AM AN ENERGY WASTER!
240

ARE YOU A LOSER, USER, OR SAVER OF ENERGY?

AN ENERGY REPORT CARD PREPARED BY MR. B'S 4-B SCIENCE CLASS

Name______________________________

RATING:
Loser ☐
User ☐
Saver ☐

Instructions: CIRCLE the correct number at the end of each question.

1. People in our house wait until they have a full load of clothes before doing the laundry:
   Never - 1
   Sometimes - 2
   Always - 3

2. Our family decides what they want from the refrigerator before they open the door:
   Never - 1
   Sometimes - 2
   Always - 3

3. People in our house take showers for:
   30 or more mins. - 1
   20 mins. - 2
   10 mins. - 3

4. The thermostat in our house is set at (pick closest one):
   80° - 1
   70° - 2
   60° - 3

5. People in our house leave unused lights on:
   All the time - 1
   Sometimes - 2
   Never - 3

6. People in our house leave curtains open at night:
   All the time - 1
   Sometimes - 2
   Never - 3

7. People in our house leave the doors and windows closed when the heater is on:
   Never - 1
   Sometimes - 2
   Always - 3

8. Our fireplace damper is closed when the fire is out:
   Never - 1
   Sometimes - 2
   Always - 3
   Don't have a fireplace - 0

9. Our house is insulated:
   Not at all - 1
   Ceiling - 2
   Ceiling & walls - 3
   Ceiling, walls & floor - 4

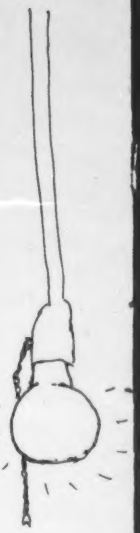
10. People in our house use a spoon instead of a blender:
    Never - 1
    Sometimes - 2
    Always - 3

11. People in our house leave the radio/TV on:
    Always - 1
    Sometimes - 2
    Never - 3

TOTAL: _____

Big Mac Energy Attack

(NEW, IMPROVED)



purpose

To illustrate the amount of fossil fuel energy required to produce a single product.

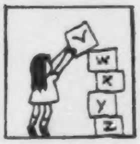
Materials: big mac poster*

Design an Energy Glow Chart by taping the Big Mac poster to the center of the chalkboard. Using the chalkboard, help the students trace the energy consumed during the processing of some of the Big Mac ingredients and packaging, from their origins in nature to their eventual refinement in the form of a Big Mac. For example the cheese originated as grass,powered by the sun; the cow was grass powered; the milk extracted by electric machine; pasteurized by gas heat; processed into cheese by electricity; sliced by an electric cutter; packaged by an electric machine; stored in an electric refrigerator; transported to market by gasoline power; etc.

Repeat simulating that it is now 1880. The cheese was cut by a human,powered by food which was powered by the sun; stored in an ice cooled refrigerator; hauled to market by grass powered horse; etc. Discuss the changes in life-style and energy use between 1880 and today.

Repeat simulating that it is now 2080. What will this scene look like?

What happened to energy use over the last 100 years? List foods which require little energy to produce. Explain the difference between processed food and natural food.



Make a list of five living things that move. It takes energy to cause something to move. Does each thing on your list have energy stored in itself to make it move, or does the energy come from a force outside the living thing? Explain.

Next, make a list of five non-living things that move. Try to figure out what type of energy causes each one to move. Decide whether movement by a non-living thing can ever happen with energy that the object itself has made, or whether the energy must come from something else. What do we in the US need to buy from other countries to give us some of the energy we use each day? What non-living things are moved by this energy we think is so very important?

Eddie Electric and Motoring Mable

purpose

To consider and discuss their values regarding energy and resource use.

This activity is a Values Continuum. It is designed to help students look at the way they use their environment and see what values this reflects. It is an adaptation from an activity in Sidney Simon's Values Clarification.

Explain to students that a continuum defines both ends as extremes and then has "gradations" in between these extremes. For example:

> 1 on a continuum might be hot and 5 on that continuum would be cold; 2, 3, 4 would be gradations between hot and cold.

Draw a line on the board with 1 at one end and 5 at the other end and 2, 3, and 4 in between:

1 2 3 4 5

Define each of the extremes (1 and 5) as though they are people. Each will have a name and at least one "energy-related" characteristic.

Tell students that you are going to ask them an energy-related question. Then you will describe the kind of person that would be found at each end of the continuum.

Have students answer the question for themselves by deciding where they would be on the continuum. Example:

*The question is: "How do you use electric energy?"

*On the #1 end of the continuum is Eddie Electric. He uses energy like there is no tomorrow. He even owns an electric page turner so he won't have to turn the pages of the books he reads.

*On the #5 end of the continuum is Barry Bulbsnatcher. He has only one light bulb for his whole house, and he carries it around from room to room.

*Say: "The question is, 'How do you use electric energy? Are you an Eddie Electric who uses energy as though it will never run out? Or are you a Barry Bulbsnatcher who is so afraid of using too much energy that he only owns

MORE

one light bulb? OR are you somewhere in between?"

*Ask for volunteers to tell the class where they think they fit on the continuum.

*Allow as many children to respond as possible. Every now and then, ask a child to give an example that would explain why s/he thinks s/he fits in that particular place on the continuum.

Other continuum ideas:

"How do you feel about using gasoline?"

#1 Bike-riding Betty. She doesn't use any gas-using vehicles at all. She rides her bike everywhere she goes.

#5 Motoring Mable. She uses the car every chance she gets. She even gets her Mom to drive her next-door to her friend's house.

"How do you use water?"

#1 Stanley Saver. He doesn't waste a drop of water. He even uses the water when he changes his goldfish bowl to water his garden.

#5 Walter Waster. He figures that he can afford to pay for all the water he wants to use, so he hoses down his driveway every evening and leaves a sprinkler going near his window all night because he likes the sound of water running.

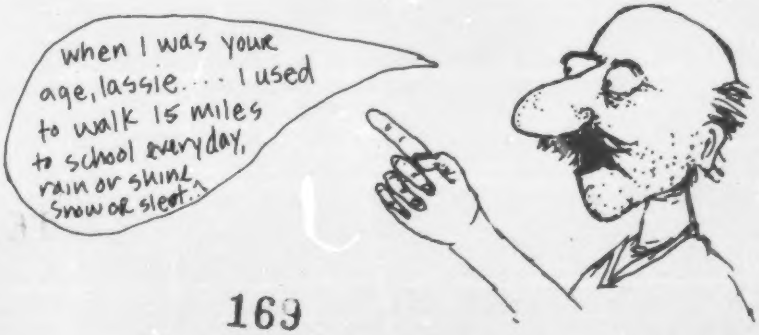
"How do you feel about air pollution?"

#1 Pure-Air Paul. He is so opposed to air pollution that he takes short breaths so he won't add as much carbon dioxide to the air.

#5 Polluted Polly. She is so uncaring about air pollution she burns her trash in the back yard because she doesn't think to put it out for the trash pick-up.

Create your own. Children can think of many other examples. Each one can lead to good class discussion on energy and environmental issues.

Discuss what was learned through this activity, individually and as a class.


when I was your age, lassie.... I used to walk 15 miles to school everyday, rain or shine, snow or sleet.

Pretzel Hog

purpose

To explore our energy needs.

Materials: Large bag of pretzel sticks, three signs - Home; Near town, Far town; masking tape, MPG cards (see next page)

ACTION This exercise can help us look at our energy use in transportation.

*Copy and cut the MPG cards.

*Shuffle the MPG cards. Each player draws one card.

*Each person gets six pretzels for gas and four pretzels for food. (Total ten pretzels for each game.)

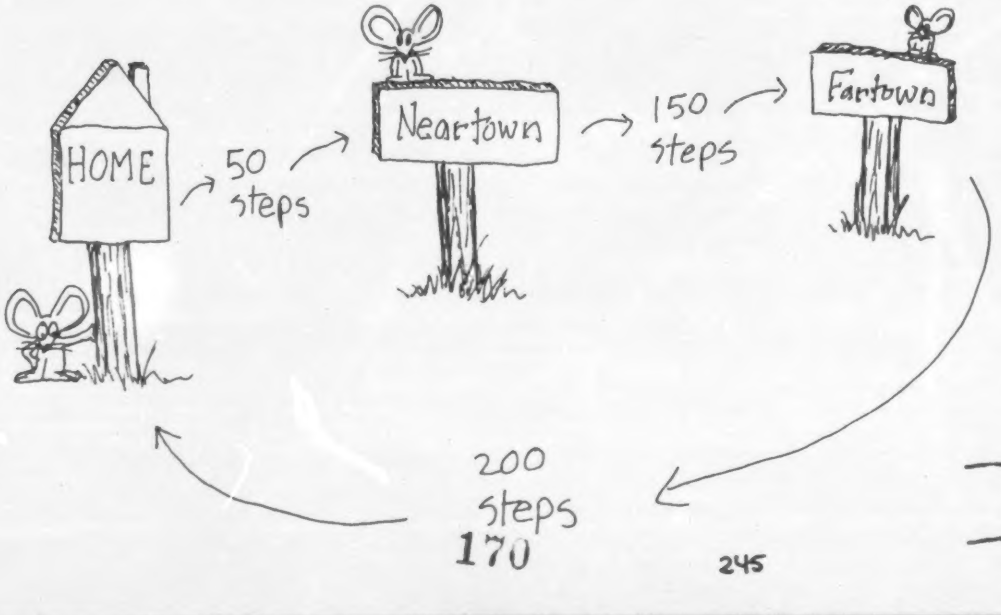
*Use one pretzel for breakfast, one for lunch, and two for dinner. Start each game with new pretzels. Don't save them.

The game is to: eat breakfast, go to work, eat lunch, go home, eat dinner. If you run out of pretzels you must stay where you are until the game is over. Play three games.

*Game 1 - Everyone works in Near-Town and drives their own car.

*Game 2 - Everyone still works in Near-Town.
How can you get everyone home?

*Game 3 - Everyone works in Far Town. If car pools won't get everyone home, think up some new solutions.



MORE

MPG CARDS

VOLKSWAGON RABBIT
29 MPG - Carries 4
(29 Steps per Pretzel)

CHEVROLET CHEVETTE
32 MPG - Carries 4
(32 Steps per Pretzel)

DATSUN B210
34 MPG - Carries 4
(34 Steps per Pretzel)

DODGE VAN
15 MPG - Carries 8
(15 Steps per Pretzel)

CHEVY LUV PICKUP
25 MPG - Carries 2
(25 Steps per Pretzel)

FORD LTD
12 MPG - Carries 5
(12 Steps per Pretzel)

FORD PICKUP TRUCK
12 MPG - Carries 2
(12 Steps per Pretzel)

CADILLAC ELDORADO
13 MPG - Carries 4
(13 Steps per Pretzel)

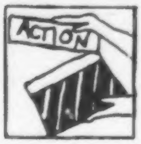
PORSCHE
17 MPG - Carries 2
(17 Steps per Pretzel)

VW BUS
22 MPG - Carries 7
(22 Steps per Pretzel)

Same-o Same-o

purpose

To have students engage in a simulation game about energy use and consumption.



Different groups of people think differently about conservation of energy.

Read the fable, "Same-o-Same-o". Discuss the story briefly, then divide the classroom into two groups: business persons and home owners. The two groups must think of ways for the town to cut down on energy consumption. Each group should list possible cuts, including new laws for future conservation. List on the board so that the differences can be seen. Have a spokesperson for each group explain their list.

Discuss the different points of view reflected. Discuss the reasons for the differences. Have the two groups agree on which cuts will be more beneficial to the town as a whole. As a class, write an energy saving policy for Same-o-Same-o.

SAME-O-SAME-O

The town of Same-o-Same-o was secluded, far away from the rest of the world. In this town, everything was always the same. People drove the same car year after year after year. They wore the same clothes for years and did the same things in their leisure time. They never changed their life-style because the same way was always the right way. The townspeople always used the same amount of electricity, gas, and water. Same-o-Same-o had one gas line and one electric line coming from Big City 2,000 miles away. The town also had only one well which used an electric pump to supply the town's water.

Then one day J.P., the daughter of the mayor, came back to Same-o-Same-o after four years of college. She was the first citizen of Same-o-Same-o ever to go away to college. She had studied business and advertising.

The first thing J.P. did was set up a Business Consulting Agency for herself. She consulted first with the gas station businessmen. She convinced them that they should advertise so people would use their cars more. This would mean more gas sales for them.

The new car dealer was J.P.'s next visit. J.P. told the dealer that through advertising, he could convince people that they needed a big, new luxurious car. The plan would make lots of money for him.

The landscaping company of Same-o-Same-o was next. J. P. suggested that people should have more plants, bigger lawns, more outside lighting, and more outside gas barbecues. It was easy to convince people that more lights would be safer, more plants would be prettier, and outdoor entertaining would be more fun.

MORE

The manager of the hamburger stand was told he should update his packaging. Each item should be packaged separately so that the amount would look larger and the food would stay warmer. J. P. convinced them that this way could save money by making the hamburgers smaller but the packaging bigger. Besides, she pointed out, packaging is only paper and plastic.

The general store owner was not left out of J. P.'s campaign. Trash compactors, electric mixers, curling irons, electric curlers, hair dryers, dishwashers, garbage disposals, washers, dryers, and electric toys were added to the store's inventory. The clothing store owner was encouraged to carry more clothes made of nylon so that they were wrinkle free. J. P. saw to it that swimming pools and Hot-Tub spas were promoted. Air conditioning was suggested for homes and businesses.

All over Same-o-Same-o, things began changing rapidly. People began buying big new cars and energy-gobbling appliances. Soon there were many swimming pools being installed. Giant green lawns were all around. Each business was air-conditioned and had a lighted sign that stayed on all night to advertise.

With Same-o-Same-o's one gas line and one electric line the town was now experiencing shortages. The city barely had enough electricity to pump water from its one well. The mayor called the townspeople together to discuss what should be done.

"We must cut down our use of energy," She said. "Maybe we shouldn't water our lawns or fill our swimming pools." "Boo," said the people with large lawns and new swimming pools. "Maybe we should cut down on the lighting for businesses and stop selling new cars," said the mayor. "Boo," said the business people.

The people of Same-o-Same-o didn't want to cut down because they were accustomed to their new way of life. The businesses didn't want to cut down because they were making so much money. Alas, such problems! Why are the people so unhappy, with so many problems, when before everyone was always happy about being the same?

Describe what happened in this story. Why did people change the way they lived? What happened to energy consumption after J. P. became a consultant. Why did the mayor call a town meeting? What do you think was the result of the town meeting?

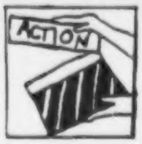
248

Sin City

purpose

To demonstrate that supplies of certain kinds of energy are finite.

Materials: energy tickets (prepare a ditto)



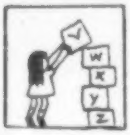
Play an "Energy Trip Ticket Game." List several places the students go in school. Charge one energy ticket for the cost of using or going to the following:

recess	pencil sharpener
special projects	drinking fountain
library	bathroom
office	lunch

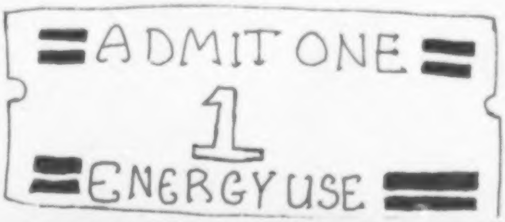
Ditto the energy tickets and give each student 30. Have the students put their names on each ticket (kids can cut out their own). Each time the student takes a trip, it costs one energy ticket. Place a box by the door and have students deposit tickets.

Keep a record of how many tickets the students have left at the end of the day. Which students are wasting energy? Which students are conserving energy? How are they doing it? Discuss energy saving ideas for trips in the school (e.g., at recess I could go to the restroom and get a drink all for one ticket rather than using three tickets). Stress the idea that in one trip we can accomplish several things.

At the point where student ticket supplies begin running low, discuss the idea of running out of tickets. There are no more energy tickets. How will we be able to finish the week without running out of tickets? What can we do to save? How will saving affect us? As the students begin to feel the pressure of conservation, relate this awareness to the actual use of energy in the "real world".



Have the students write a story: "The Day the Energy Ran Out".



ONE ENERGY TICKET (1)	ONE ENERGY TICKET (1)	ONE ENERGY TICKET (1)	ONE ENERGY TICKET (1)
ONE ENERGY TICKET (1)	ONE ENERGY TICKET (1)	ONE ENERGY TICKET (1)	ONE ENERGY TICKET (1)
ONE ENERGY TICKET (1)	ONE ENERGY TICKET (1)	ONE ENERGY TICKET (1)	ONE ENERGY TICKET (1) 250
ONE ENERGY TICKET (1)	ONE ENERGY TICKET (1)	ONE ENERGY TICKET (1)	ONE ENERGY TICKET (1)
ONE ENERGY TICKET (1)	ONE ENERGY TICKET (1)	ONE ENERGY TICKET (1)	ONE ENERGY TICKET (1)
ONE ENERGY TICKET 176 (1)	ONE ENERGY TICKET (1)	ONE ENERGY TICKET (1)	ONE ENERGY TICKET (1) 177

The Great Gearloose Creation

purpose

To have students develop a new form of transportation suited to the needs of a fossil fuel poor world.

Materials: construction paper, crayons

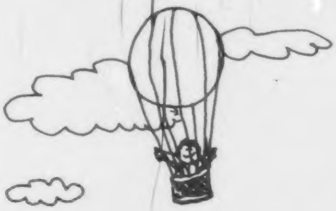
Future energy and transportation systems may be very different from today's standards.

If you have an imagination, you will have fun with this. Just let your creativity run wild!

Imagine that you are Gotta Gearloose, a scientist and inventor who lives in the town of Fairview. Many citizens in our town have complained to the mayor that the air is not as clean as it used to be, gas costs too much, noise levels are too high, etc. Because she is running for reelection, Ms. Win D. Bag, the mayor, has decided to do something about the problem (immediately, if not sooner!). She has decided to ban all automobiles as a form of transportation. She has asked you, Gotta Gearloose (world famous inventor), to design a new form of transportation that will not pollute the air.

Think about these questions before you begin:

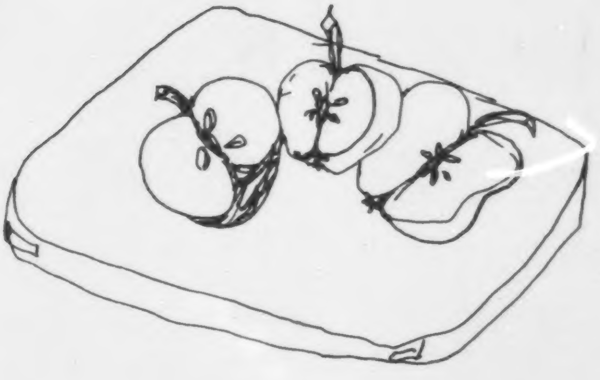
*What kind of energy will your new form of transportation use?
*Will it go on land, in the air, on water, underground, or all four?
*How many people will it carry?
*How big will it be (size-wise)?
*What will it look like?
*How fast will it go?
*How safe is it?
*How often will it need to be repaired?
*What will you name your creation?



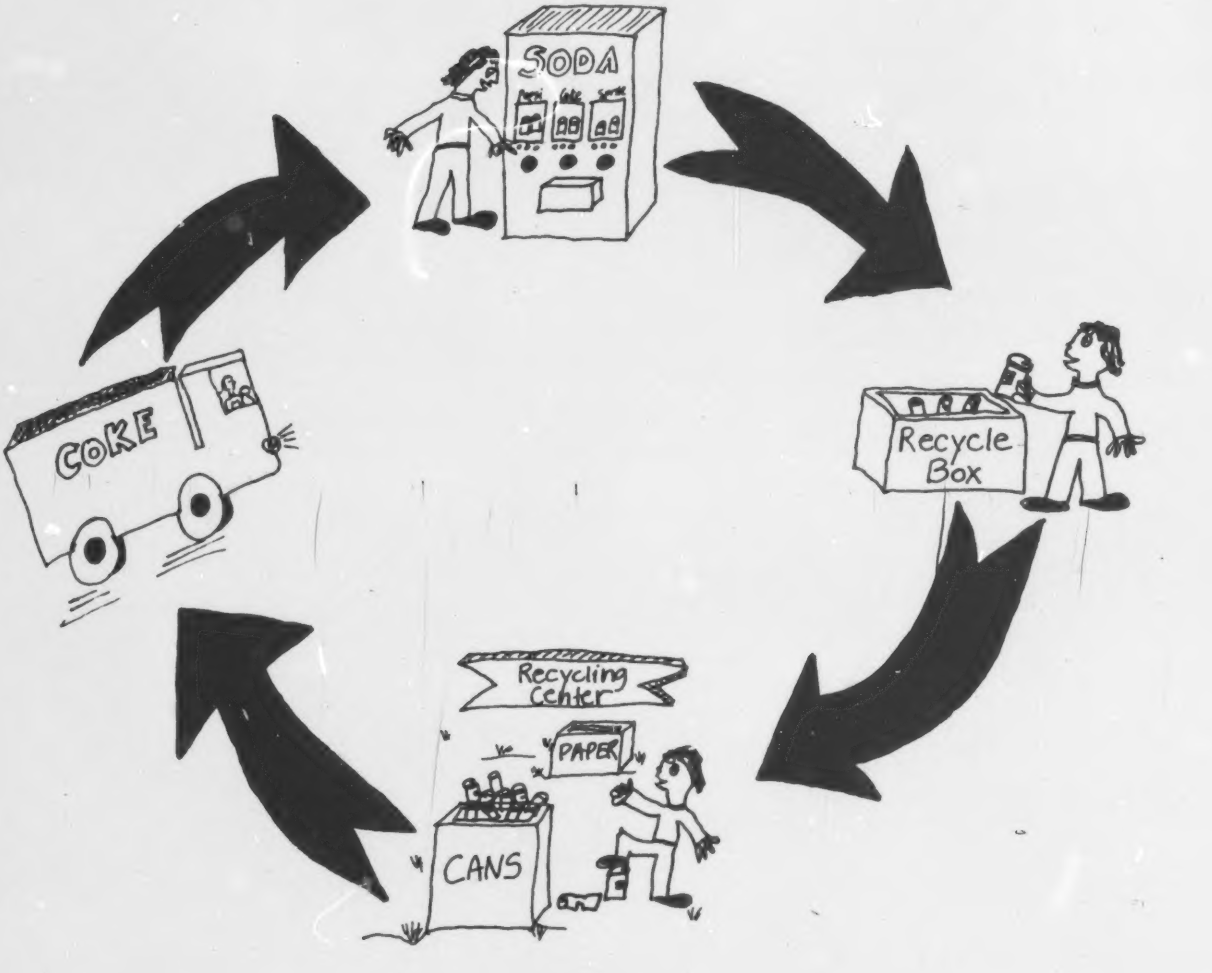
Draw a picture of your pollution-free form of transportation and write a paragraph describing it.

Share your creation with the class. Answer the above questions in your presentation.

Design an energy efficient town of the future.



RECYCLING


SODA
Pepsi
Coke
Sprite
Recycle Box
Recycling Center
PAPER
CANS
COKE

This unit is an ideal follow-up to the energy unit, where students explored the uses and abuses of energy and were introduced to the concept of conservation. Recycling is the one down-to-earth conservation method that kids can do. It may be hard for a 3rd grader to insulate his/her home -- but collecting aluminum soda cans is as hands-on as they can get.

In this recycling unit, students will (have the opportunity to) learn how the cycle of recycling works, how their habits of resource use and disposal are part of that cycle, what can be done to reuse and reduce their wastes.

Lesson Titles	Recommended Grade Levels
Circle - Cycle - Recycle	2-6
The Cycle of Recycle	2-6
Freeways Full Of Garbage	2-6
Self Survey	2-6
A Human Paper Factory	2-6
Mysterycycle Guessing Game	2-6
Recycling At Your School	2-6

Special Materials & Where To Find

Film, Recycling Our Resources - See material sheet attached to Circle - Cycle - Recycle lesson.

* The above material is listed to assist you in locating it. All materials are listed with each lesson and most are readily available.

This unit written and illustrated by the skilled hands of Dawn Binder.

Circle-Cycle-Recycle

purpose

To introduce students to some fundamental concepts of recycling.

Materials: Poster "The Cycle of Recycle", Film Recycling Our Resources,*(see attached sheet for materials references)

ACTION

*Review with class the meaning and examples of cycles: (see p.171). Write the word CYCLE on the board. What does this word mean? What are examples of cycles? (seasons, oxygen cycle) A cycle can be defined as a circle that repeats itself over and over.

*Write the letters RE in front of CYCLE to make RECYCLE. What does this word mean? How is the re-cycle a cycle? Show and discuss the poster "The Cycle of Recycle". How does the paper cycle begin? Does the cycle have any end? Trace through the entire cycle for paper. Which step in the cycle do you think is most important? Why? If the paper ends up at the dump is it still part of the re-cycle? Why/Why not?

*Ask the students to make a list on the chalkboard of items that can be recycled. Which members of the class already collect items to recycle? What kinds of things do they collect? Why do they do it? Ask the rest of the students in the class why they don't recycle. Make a list on the board of these reasons. Discuss.

*Show the film Recycling Our Resources (10 minutes). Afterwards discuss more in depth the concepts of recycling as shown in the film. How can recycling help solve problems of pollution, energy shortages, overcrowded city dumps, and high utility bills? Why do we save money by recycling? Predict what kinds of things may happen in the future (near and far) if more people don't recycle.

MORE

Materials Guide

Films

The film recommended for Lesson #2 is:

☆ Recycling Our Resources	3rd grade and up. 10 minutes, color.

If this film is not available through your school district then one of the following films should be

Let's Help Recycle	4th-7th grades 11 minutes, color
Uncle Smiley Goes Recycling	K-6th grades 13 minutes, color
The Great All American Trash Can	K-6th grades 13 minutes, color
Recycling In Action	6th grade and up 14 minutes, color

Products Made From Recycled Paper

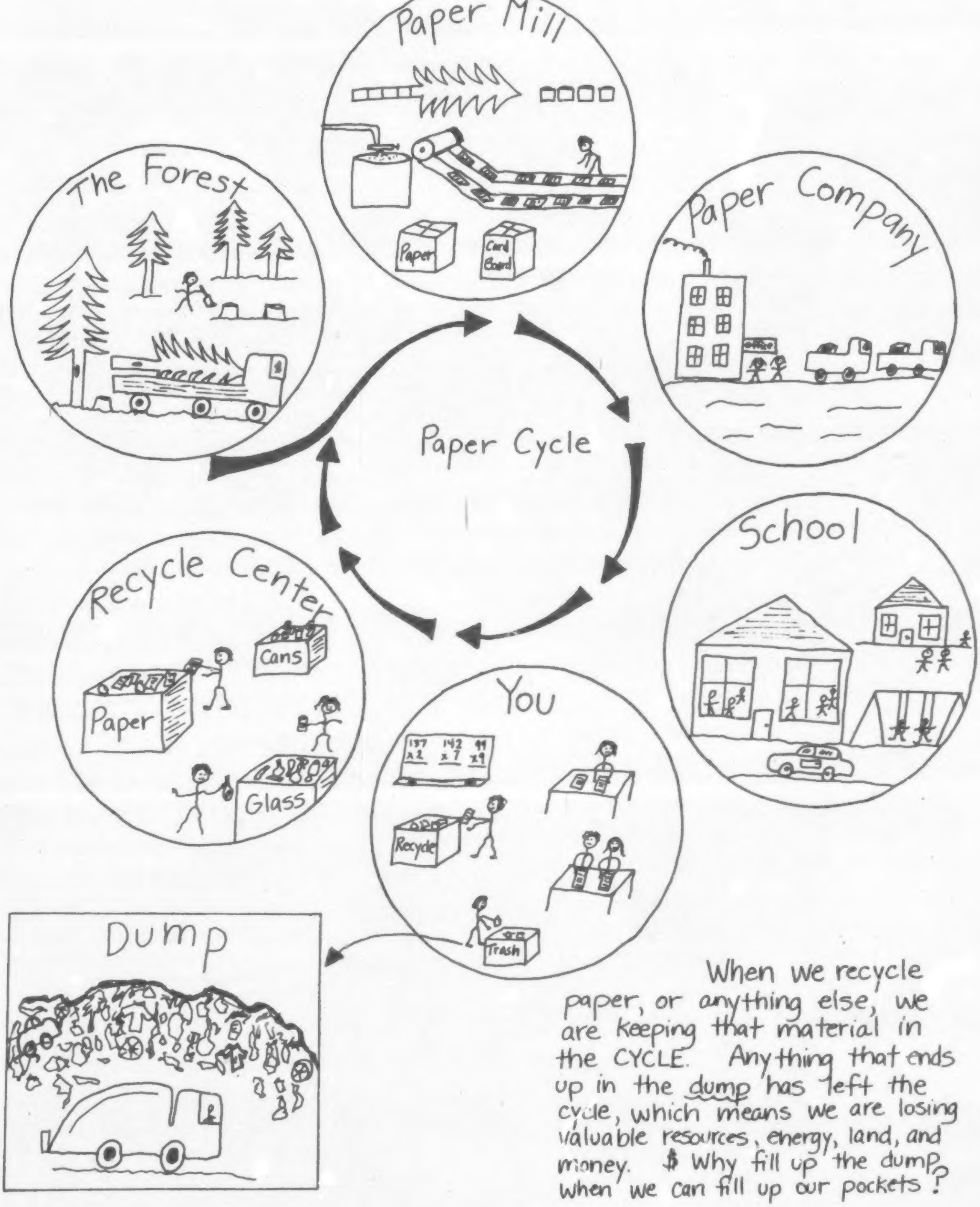
For Lesson #5 you will need to collect (or have the students collect!) the following items which are made from paper which has been recycled.

- newspaper
- brown paper bag
- napkin
- cardboard box
- toilet tissue
- cereal box
- construction paper
- writing paper
- stationery, envelope
- book

Almost all paper products can be made from recycled paper, rather than from new wood-paper pulp. Help support those companies that DO invest in using recycled materials. Look for this symbol

CONTAINS RECYCLED MATERIALS®

The Cycle of Recycle


Paper Mill
Paper
Card Board
The Forest
Paper Company
Paper Cycle
School
Recycle Center
Cans
Paper
Glass
You
137 x2
142 x7
99 x9
Recycle
Trash
Dump

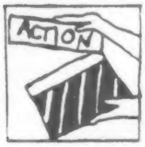
When we recycle paper, or anything else, we are keeping that material in the CYCLE. Anything that ends up in the dump has left the cycle, which means we are losing valuable resources, energy, land, and money. $ Why fill up the dump when we can fill up our pockets?

Freeways Full of Garbage

purpose

To illustrate how the "garbage explosion" is becoming a serious problem in America, a problem which each of us helps or hurts by our daily habits of materials use, misuse, and reuse.

Materials: Poster "A Short History of Trash", student self-surveys, worksheets "Trash Tally".

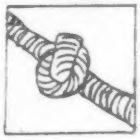


*Discuss-Introduce
Everyday we use materials--paper, metal, glass, plastic, wood--and everyday we make decisions about whether to throw away or recycle those materials. Often we don't even think about how we are using our resources; we take them for granted and just throw them away out of HABIT.

*Use this self-survey to find out what your personal habits are in the area of garbage and recycling. When you complete the survey add up the points and then read the back page for more information. Discuss the questions and responses of the students.

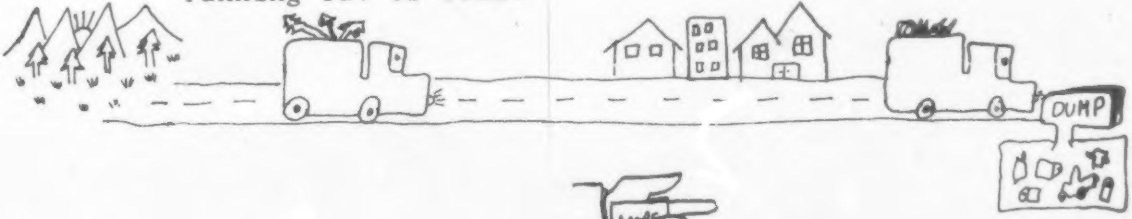
*Now go back and do the survey again. Use a different color pen or pencil to circle the responses you would give if you could change your habits. How could you be convinced to recycle more and throw away less?

*Show the poster "A Short History of Trash". Why has the amount of garbage people make increased so much in the last 30 years? (over 50% increase) List some reasons on the board why this is happening. The average American throws away over 1 ton of trash each year. That much trash would fill your bedroom from floor to ceiling! In the state of California for 1 year people throw away 146 million tons of trash. Picture this: that much trash would make a ten foot tall solid block filling 2 freeway lanes all the way from Oregon to Mexico. And that's only 1 year's worth. ☆☆☆



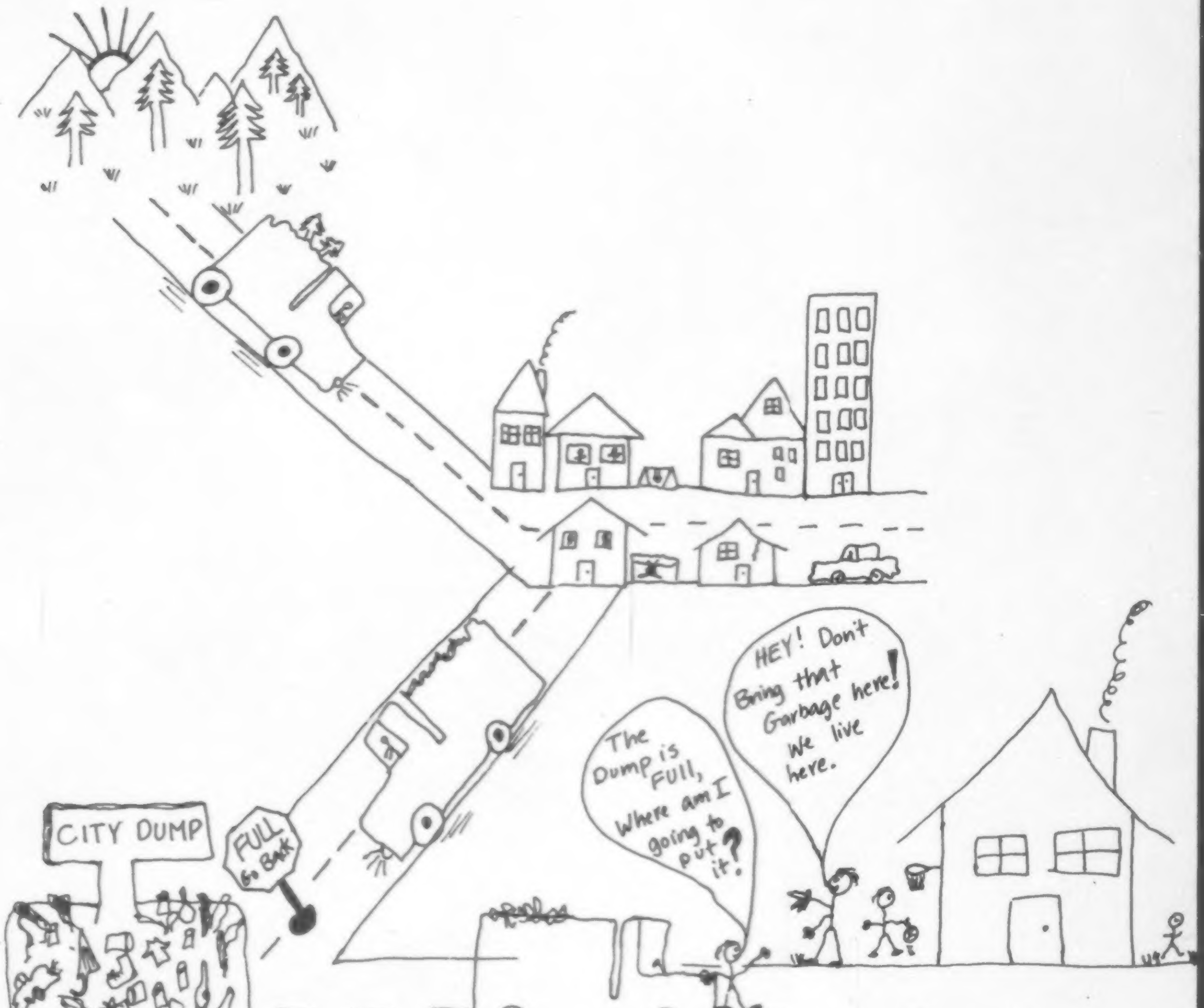
Where does all that garbage go? What kinds of problems does garbage make.

Where is the dump site in your city? Are you running out of room?

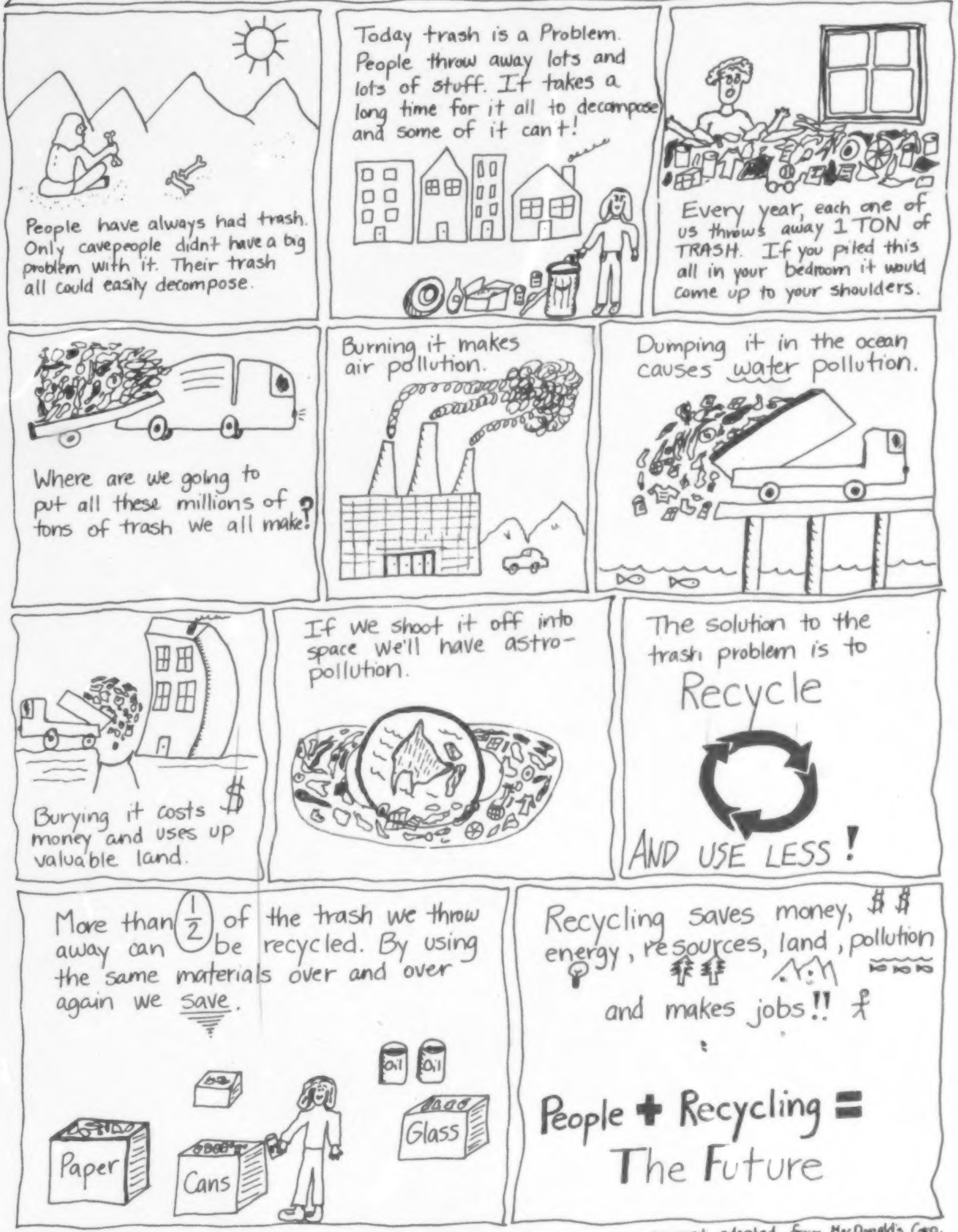


258

Use the "Trash Tally" worksheet to discover what your contribution to the city dump is. Do you throw away 1 ton of trash each year? Before working on the worksheet, write down your guess about how many pounds of trash you throw away in a year. Save this and compare it to what you find out from the Trash Tally. Also, try recording the weight of the trash from your classroom. Discuss the results of the tally. Do the self-survey and Trash Tally show similar results about your habits?


CITY DUMP
FULL Go Back
The Dump is FULL, Where am I going to put it?
HEY! Don't Bring that Garbage here! We live here.

A VERY SHORT HISTORY OF TRASH


People have always had trash. Only cavepeople didn't have a big problem with it. Their trash all could easily decompose.
Today trash is a Problem. People throw away lots and lots of stuff. It takes a long time for it all to decompose and some of it can't!
Every year, each one of us throws away 1 TON of TRASH. If you piled this all in your bedroom it would come up to your shoulders.
Where are we going to put all these millions of tons of trash we all make?
Burning it makes air pollution.
Dumping it in the ocean causes water pollution.
Burying it costs money and uses up valuable land.
$
If we shoot it off into space we'll have astro-pollution.
The solution to the trash problem is to
Recycle
AND USE LESS!
More than 1/2 of the trash we throw away can be recycled. By using the same materials over and over again we save.
Oil
Oil
Paper
Cans
Glass
Recycling saves money, $ $ energy, resources, land, pollution
and makes jobs!!
People + Recycling = The Future

concept adapted from MacDonald's Corp.

SELF-SURVEY

Every day you make decisions about how much garbage you throw away, and how much you recycle. Most of the time these decisions are just HABITS.

What are your Trash Habits? Find out by taking this self survey. When done, add up your score and read the back for more information.

DO YOU....

Circle the number

	Never	Sometimes	Often
1. Use both sides of a paper before getting a new piece?	3	2	1
2. Avoid eating take-out food that is wrapped in many different packages?	3	2	1
3. Use dishes instead of paper plates?	3	2	1
4. Reuse plastic and brown paper bags?	3	2	1
5. Save newspapers to recycle?	3	2	1
6. Keep a compost pile at home for kitchen scraps?	3	2	1
7. Shop at garage sales and thrift stores?	3	2	1
8. Use cloth napkins instead of paper napkins?	3	2	1
9. Save soda cans instead of throwing them away?	3	2	1
10. Recycle scrap papers in your classroom?	3	2	1
11. Try not to buy plastic products?	3	2	1
12. Fix things instead of throwing them out?	3	2	1
13. Give outgrown clothes to someone smaller?	3	2	1
14. Remind your friends to recycle?	3	2	1
15. Reuse glass jars in your kitchen?	3	2	1
16. Give magazines to other people after reading?	3	2	1
17. Think of new ways to reuse old things?	3	2	1
18. Buy products that will last a long time?	3	2	1
19. Think about what happens to things sent to the dump?	3	2	1
20. RECYCLE AS MUCH AS YOU CAN?	3	2	1

★ Add up the columns for your Grand Total → ☐ + ☐ + ☐ =

SELF-SURVEY

My Grand Total is ________

☺ The lower your score, the better your habits are.

☆ Less Is Better ☆

When it comes to

TRASH

If your score is

50 or more	**30-50**	**30** or less
Your trash habits could use some improvement. You are adding more than you need to the city dump, and sending little to the recycle center. Try reusing items before trashing them. Buy fewer packaged things. Every Little Bit Counts	Your habits are pretty good, but you could be doing more to Reduce Reuse Recycle Try composting your food scraps at home, or recycling at school to cut down your trash.	Your trash habits are GREAT. You must be very involved in recycling. Keep up the good work. Talk to your parents and friends about how to RECYCLE. Think up some creative ways to make even LESS Trash.

NOW go back and do the self-survey again. Use a different colored pencil or pen to circle the numbers. This time ask yourself "Could I . . ." before each question. Which of your trash habits could you change? Which ones do you want to change?

Remember... every soda can you collect on the street, every plastic container you decide not to buy, every paper you recycle at school - It all Adds up to money saved, trees saved, resources saved!!!